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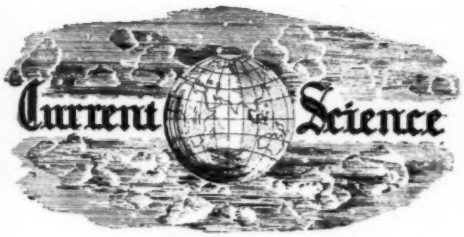

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CONTENTS.

Over-Population in India.

In an extensive note recently published in the press, the Public Health Commissioner with the Government of India was reported to be contemplating a discussion of the problem of over-population in India in an article about to appear in the *Indian Medical Gazette*, and also as making a suggestion, that the Federal Administration should deal with the issue of family limitation as a remedy for combating the baleful consequences, resulting from an uncontrollable increase of population. In many provinces large masses are at the level of bare subsistence, with hardly any clothing or house furnishings but possessing quite a remarkable power of fecundity. Few will fail to be impressed by the prevailing misery, squalor and poverty of the Indian people, and among the numerous public matters with which the Government of India will shortly be confronted, the subject of raising the economic level of the country and of improving the standard of living of the common people must necessarily occupy the foremost place.

Modern civilisation is full of paradoxes. In the midst of plenty people are allowed to suffer. The banks are embarrassed by a plethora of money, but are unable to release the funds for providing relief to the unemployed. Gold always regarded as an incorruptible standard of currency, has been deflected from its appointed task, with the inevitable effects of discouragement and arrest of business involving human unhappiness. Increase of population considered a sign of public prosperity in the past, has now become a menace. These strange and alarming phenomena in human affairs must inevitably puzzle the ingenuity of all Governments, and perturb the hearts of public leaders. It seems to us that at the root of all these troubles lies the currency problem. The recent policy of sovereign governments of hoarding gold and silver is obviously due to the apprehension of a shrinkage in their supply, and their immobilisation paralyses trade and increases unemployment. If the world would adopt a form of currency, incapable of maldistribution or of being cornered, which could be used purely as a counter or a cheque between services and commodities, perhaps the other social problems might admit of easy solution. It is the inefficient system of world economics that has made some of the existing population superfluous, and the

remedies suggested for restricting the increase are in the nature of an experiment in human biology.

We know that the humanitarian measures, which governments and voluntary public services have adopted for the promotion of the peoples' health and happiness, provided also the causes leading to an absolute increase of population. But no one can seriously suggest the suspension or repeal of all attempts at sanitation and the prevention of disease, the provision of famine relief measures or the protection of the person and property of the people as one of the remedies for over-population. It may be possible to absorb the superfluous population by an extension of irrigation, improved methods of agriculture, emigration and closer settlement of sparsely inhabited lands and by developments in industry and commerce. The limits of what can be done in these directions must be reached sooner or later, and possibly in most parts of the world they must have been already reached. It is legitimate therefore for public leaders to suggest the popularisation of contraceptive technique as an infallible remedy for limiting the number of births, and every child knows that population of manageable dimensions can have more food, better accommodation, higher expectation of life and greater facilities for racial improvement.

Scientists may soon be in a position to estimate exactly what human population India can carry at a tolerable level of existence, providing for freedom, happiness and all the richness and variety implied in a full and complete life. Till we get an idea of the estimated maximum population, the term over-population must continue to be used as a vague one, for reckonings based on insufficient assumptions can have very little practical value. It has to be borne in mind that the numbers of human population alone do not press steadily on the means of subsistence, a large percentage of which being destroyed by other species of animals. Further a large quantity of food good enough for human mouths goes to support stray animals and domestic pets, apart from what is thrown away as waste. We can fairly comprehend the total volume of food consumed by the larger mammals, rodents, birds and insects in the wild state, and by other animals which hang on the outskirts of society rendering little service. We practically ignore the loss of food due to animal depredations when we describe over-population as signifying that in a given area at a given time there are more people than the produce of land can support in a reasonably comfortable existence. We are not pointing to this source of loss as an argument against the suggested remedies for controlling over-population, and we are fairly certain that all the forces arrayed against the general practice of contraceptive methods will be utterly futile to check its progress, for the knowledge relates to an imperious biological process, which interests mankind more than food. In any sphere of human thought and action, freedom without responsibilities is dearly coveted by every one, and critics of birth control point out that the doctrine of the Malthusian League favours such freedom. They desire to know whether the dissociation of freedom and its attached responsibility in society will favour its refinement and ennoble its conscience, where such alienation in the political sphere is apprehended to lead to anarchy. They ask whether the effect which the cause is prevented from producing, will not manifest itself in some other form, or whether in Nature or in the human system, an act can be perpetrated without entailing appropriate consequences. No doubt the advocates of birth control must have thought about such questions and must have satisfied themselves that the practice, which they seek to popularise, is not limited to the single problem of food, but that it really embraces all the aspects and spheres of human existence.

The population of India is about 19 per cent. of the total population of the world, and the rate of increment from 1872 has been 23·2, 13·2, 2·5, 7·1, 1·2 and 10·6 per cent. The actual increase, according to the latest Census Report, since 1921 is 33,895,293 which represents 10·6 per cent. at the last census, and more than 39 per cent. on the population of India fifty years ago, and an increase of 12 persons per square mile in 50 years, during which time the increase in area has been principally, if not entirely, confined to comparatively thinly-populated areas, amounting to 426,055 square miles. During this period the birth rates of various European countries have fallen, England and Wales 36·3 to 17·8; Germany 40·9 to 20·7; Italy 39·2 to 27·8 and Sweden 30·8 to 16·9. There are many interesting subtleties regarding the statistics of population, and according to the computations of American authorities the total optimum population of the world is 350

millions, which is less than the population of India. The optimum population of any country must depend largely on the standard of life, and as there is every need for raising this standard in India, it is obvious that its present population is far above the optimum. India is passing through the opening phase of rapid multiplication, fostered by modern industrialism such as occurred in the European countries from the first appearance of factory manufacture in the eighteenth century upto the seventies of the nineteenth. Indian leaders are of opinion that her prosperity depends upon industrial expansion more than on her agricultural pursuits, and that the country should cease sooner or later to import foreign manufactured articles. This decision involves the reproducing in all factory centres the identical conditions which led in the European countries to the enormous increase of their population. We have to add to such conditions the elimination of all natural checks upon the numbers of a less organised community with little education and a poor standard of living. The minds of people are not troubled by what is known as the rapid multiplication of the unfit and by their own relative poverty. The message of birth-control is a far cry to them, and their education and religious principles have not sufficiently fortified their minds to practise abstinence and self-control. Judged by the gross conditions in which the poorer communities live, a further increase in the total population of India seems inevitable.

Recent authors on the population problem in India have drawn attention primarily to the question of food production. The argument is that the population of India is already living permanently on the verge of scarcity, and any addition is bound to result in an insufficiency of the food supply. The advocates of birth-control emphasise that women who bear numerous children are subjected to miseries, that they lose their reserve vitality, and that the children are undernourished and are indifferently educated. We are not dealing here with the question of maximum population possible in India, but with the other question of maximum population desirable, and in this connection it is essential to have an accurate estimate of the degree to which the recent rise in number has taxed the ability of the country to support its occupants at a reasonable standard of living. The position of the economists in the European countries now appears to be that even if the low birth rate is reversed to former proportions, the rapid development that is taking place in the world production of food would be adequate to meet any such increase. It is doubtful whether, within the next decade, the production of food in India, in spite of rapid researches in the mechanical and biological fields of agricultural occupations, will be sufficient to cope with the increasing numbers. Nevertheless it is reasonable to suppose that the general adoption of improved and intensive methods of cultivation might result in an increased output of at least 30 per cent. throughout India. If in the total cultivable area the process of raising crops was brought under scientific control, and if by any chance the present population of India was not allowed to increase, there can be little doubt that the standard of living of the masses would rise rapidly. But the apprehension is that the population shows a tendency to multiply, unless the law which governs increase is artificially suspended. Is this apprehension based on any scientific theory?

Those who have investigated the population problem point out that this inevitable increase need not necessarily bring misery in its train, since "the orderly evolution of human knowledge justifies us in assuming that science will keep pace in discovering means of expanding opportunities of happy human existence", and the human organism is endowed with the power of adapting itself to an extent not yet imagined. Even if the existence of any community is threatened by an uncontrollable multiplication of its numbers beyond the means of subsistence, Nature has sufficient reserves in maintaining the balance by governing the ratio of fertility unassisted by any extraneous intervention. That Nature has not relinquished her laws of maintaining a definite relation between the maximum desirable population and the means of subsistence is illustrated in the case of the Arab population of Algiers, who show both a decrease in the birth rate, which could not be ascribed to any voluntary practice of contraceptive technique, and a decrease in the death rate which equally could not be ascribed to improvements in public health measures. Attempts to effect a retardation of the rate of increase by voluntary limitation of the birth rate because of the diminution of returns from the land require closer investigation, before any scientific conclusions can be formulated.

The second argument that repeated child bearing involves misery to one section of the Indian population which, it is only human to relieve, is a powerful one, and apparently justifies the wide-spread practice of family limitation by artificial methods. In one of her recent papers published in India, Dr. Marie Stopes has pointed out that the apparatus required by the general masses will cost practically nothing and the means of prevention of conception are available in the poorest houses. The argument that man lives in an artificial society, and that his productivity must be governed by artificial means is generally acceptable, but his bodily functions remain natural and obey the simple laws of metabolism. He retains sufficient plasticity to be affected by the environment he has created for himself. It is well known that the researches of American authors on the reproduction rates of social groups have produced evidence of a negative relationship between educational advance and fertility; further it is almost a demonstrable fact that full-time paid occupations of women are found incompatible with effective reproduction in any large community. Unhealthy crowding in slums seems to raise fertility, but the rural developments which the Government of India and provincial authorities have inaugurated with the object of ensuring decent environment and attractive housing for the poorer classes, and the campaign against congested areas in populous towns must counteract forces conducive to high fertility among families least equipped for this responsibility.

We are not arguing against the new doctrine of family limitation. Its object is, however, gradually realised by the operation of those social phenomena which we have noticed. It is established by the American school of investigators with a fair measure of probability that education, occupation, better housing and a higher standard of life have individually the power of affecting more or less permanently the rate of fertility. The hope of restricting the population of India seems to lie more in the rapid and energetic promotion of those social developments which must inevitably effect fertility rate, than in the promotion of the artificial methods to which sentiment and custom are hard to be reconciled. The results in the latter case are spectacular, but those arising from the former must be progressive and slow.

English as the Common Language of India.

WITHIN the last two months there have been many notable public utterances on this subject. Vernaculars are generally favoured as the medium of instruction, and some of these languages have sufficiently developed to be adopted for this purpose. Urdu is now used in the Osmania University for imparting instruction in all the branches of scientific and humanitarian knowledge, and few will doubt its capacity to galvanise the national intellectual life. Hindi, Bengali and Marathi possess an equally rich literature, and like Urdu they possess all the flexibility and assimilative power of a virile and growing language. The vernacular press, which is an efficient instrument for instructing and interesting the masses in public affairs, has been increasing in large numbers, and, given the proper encouragement, some of them are bound to exercise a great influence on the thoughts and aspirations of the people.

Sir Martin Forster, in his illuminating presidential address delivered during the Education Week Celebrations of the Bangalore Educational Association in the second week of this month, quoted the following significant sentence from a speech addressed by Babu Rajendra Prasad to the students of Madras. The latter recognised "one great advantage in the English language and English literature which you cannot get elsewhere. The English literature is full of the ideals of freedom and liberty which Englishmen have cherished". In the Convocation Address to the Annamalai University which, for breadth of view and clear grasp of the fundamental problems, is really brilliant, Amin-ul-Mulk Sir Mirza Ismail remarked, "To my mind the antithesis (vernacular and English) is both superficial and unnecessary ....English is undoubtedly a most useful language to learn from every point of view,—social, cultural, educational and political,—and no University in India can afford to neglect it." Mr. C Y. Chinthamani in his Convocation Address to the University of Mysore deprecated the use of English as the common language of India. Sir Mirza Ismail and Sir Martin Forster viewed the problem from a higher standpoint, when they drew attention to the value of the English language, "as a constituent of Indian National efficiency, and its relation to the share that India is destined to assume in the problem of Internationalism."

The Ultracentrifuge and Its Applications.

By The Svedberg.
(*Fysikalisk-Kemiska Institutionen, Upsala.*)

ZSIGMONDY'S monograph "Zur Erkenntnis der Kolloide" which appeared in 1905 is to be looked upon as one of the mile-stones along the road of advance in colloid science. In this book was collected the experimental material showing conclusively that a great number of apparently homogeneous pseudosolutions or colloids are really heterogeneous in nature, being built up of small particles suspended in a liquid. The new means used for carrying out these observations was the ultramicroscope constructed by Siedentopf and Zsigmondy in 1903. By way of analogy it appeared probable that all colloids are similarly built.

The ultramicroscope, however, has two serious limitations. In the first place, it can only make visible particles the index of refraction of which differs greatly from that of the solvent (or dispersion medium, as the "solvent" of colloids is usually called). Only in especially favourable cases, such as gold, platinum and silver particles, is it possible to penetrate down to sizes of the order of $5m\mu$. The wide and important domain of lyophilic colloids, such as sulphur, ferric oxide, silicic acid, proteins, starch, cellulose, rubber, can only to a very limited extent be explored by means of the ultramicroscope. In the second place, it is to be noted that an ultramicroscopic study even in the favourable case of, say, a gold colloid, can only give rather incomplete information with regard to the statistical distribution of the various particle sizes present in the colloid solution.

Zsigmondy's monograph impressed the writer greatly when he, as a young research student, became acquainted with it. Mainly through its influence his studies were directed towards research in colloids. During these activities the limitations of the ultramicroscope became evident to him and he soon found himself engaged in a search for some other means of attack in cases where the ultramicroscope failed. The brilliant work of Perrin (1908) on the Brownian movement and the sedimentation of small particles suggested some method built on diffusion, osmotic pressure and sedimentation. It should be possible, so the writer argued, to combine these properties so as to dispense with the necessity of making the particles visible.

After some preliminary work on diffusion and sedimentation of colloids (1911) and after Odén had carried out in the writer's laboratory his beautiful researches on the size-distribution of particles by means of a self-recording balance (1916) which measured the accumulation during sedimentation in the field of gravity, the writer decided to try the possibility of studying particle-size and size-distribution curves by means of the centrifuge (1922). Earlier attempts in this direction did not seem very encouraging. The first trials made by Nichols and the writer in the chemistry department at Wisconsin (1923) showed, indeed, that this road would not be an easy one to travel along. In the first place, it was evident that all measurements had to be done while the sample was rotating at constant speed. Accordingly only optical methods could be used for recording the sedimentation. In the second place, the centrifuging had to be conducted at constant or only slightly and uniformly varying temperature. These two conditions have to be fulfilled in order to obtain convection-free sedimentation. In the third place, the centrifugal field created within the solution to be studied should be of high intensity and homogeneity.

The conditions for convection-free sedimentation were studied by Rinde and the writer (1924) using fine-grained gold sols as test objects. It was found that the sample must be sector-shaped, completely enclosed and of not too large dimensions. The friction against the surrounding gas has to be reduced and the heat from the bearings kept away. We found it possible to perform faultless sedimentation in centrifugal fields 5,000 times the force of gravity (mean radius 45 mm., height of column of solution 15 mm., speed 10,000 r.p.m.) and to measure the size-distribution in gold sols down to the most fine-grained ones. The name ultracentrifuge was proposed for this new research tool.

Using the same apparatus Fåhræus and the writer (1925) succeeded in determining the molecular weight of proteins by means of sedimentation measurements. Evidently the ultracentrifuge would be of great value

as a research instrument in the study of high-molecular compounds. Feeling convinced of this the writer decided to do his best to develop further the ultracentrifuge idea.

In 1926 F. Ljungström, A. Lysholm and the writer reached 100,000 times gravity (mean radius 52 mm., height of column of solution 12 mm., speed 45,000 r.p.m.). In the spring of 1931, further improvements of the machinery accomplished by G. Boestad and the writer made possible sedimentation measurements at 200,000 times gravity (or 200,000 g.), (mean radius 65 mm., height of column of solution 12 mm., speed 54,000 r.p.m.). Using the same radius and the same height of column of solution we reached 260,000 g. early in 1932, 300,000 g. in the spring of 1932 and 400,000 g. in the spring of 1933.

measurements made in very intense centrifugal fields using a low column of solution and a small mean radius with such made in somewhat less intense fields using a higher sample situated farther from the centre of rotation has shown that the accuracy is much better in the latter case at least as far as sedimentation velocity measurements are concerned. For a standard equipment, therefore, a large rotor is to be preferred.

From the many different experimental machines built in Upsala two standard types have been developed. The first one is adapted for the region 500 to 15,000 g., the other one for the range 15,000 to 750,000 g. The low-speed machine is driven directly by a high-frequency motor and is provided with ball-bearings. The rotation takes place in hydrogen of atmospheric pressure and the casing is immersed in a

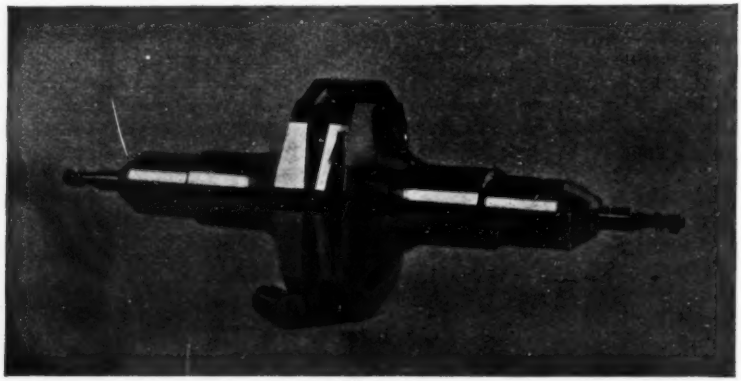


Fig. 1.

Rotor and cell for centrifugal fields up to 750,000 times the force of gravity.

Essentially higher fields cannot be utilised with rotors of this size because of failure of the material. It seemed of interest to try a smaller rotor type capable of giving considerably higher intensities although at the sacrifice of height of column of solution and homogeneity of the centrifugal field. Reducing the mean radius to 36 mm. and the height of sample to 8 mm. sedimentation measurements in fields up to 600,000 g. were made in the autumn of 1933 and up to 900,000 g. in the summer of 1934. The rotors used in these experiments exploded however after a few runs. A further reduction of the mean radius to 32·5 mm. and improvements in the construction have made it possible to do regular measurements in fields up to 750,000 g. The comparison of

water thermostat. It is used for sedimentation equilibrium measurements in solutions of high molecular substances and for sedimentation velocity measurements on heavy particles.

The high-speed machine is driven by oil-turbines and has white-metal bearings with movable, damped pistons. The rotor spins in hydrogen of reduced pressure. It is used for velocity measurements in solutions of high-molecular compounds and for equilibrium measurements on low molecular substances.

A few details concerning the oil-turbine ultracentrifuge might be of interest. The rotor (Fig. 1 and 2R) of chromium-nickel steel is supported by horizontal bearings, B_1 and B_2 (Fig. 2), and kept in rotation by

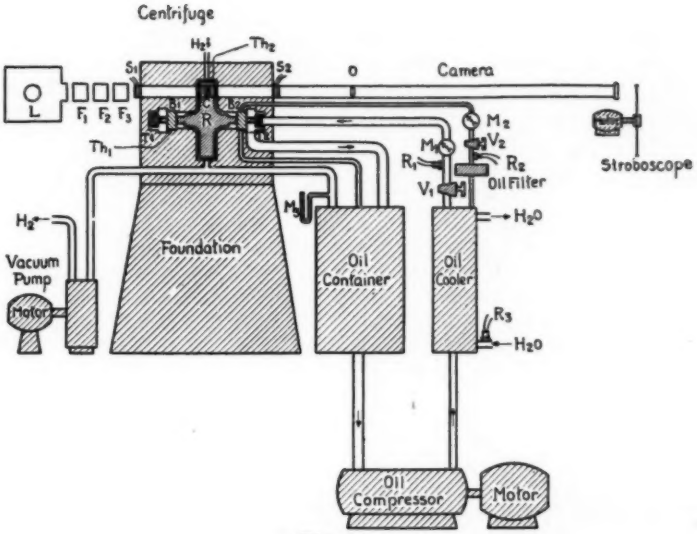


Fig. 2.

Diagrammatic representation of the oil-turbine ultracentrifuge.

means of two small oil-turbines, T_1 and T_2, one on each end of the shaft. Hydrogen is let in at the periphery and constantly pumped off so as to maintain a pressure of about 25 mm. Thermocouples, Th_1 and Th_2, in the bearings and at the inner surface of the heavy steel casing, which surrounds the rotor, serve for temperature control of the centrifuge. A beam of light from a mercury lamp L, filtered through F_1, F_2, F_3, passes the cell C in the rotor on its way to the camera. The exposures are timed by means of the electromagnetic shutters S_1 and S_2. A stroboscope enables the observer to measure the speed of the rotor. The pressure oil which feeds the turbines is produced by a special oil compressor and cooled to a suitable temperature before entering the turbine chambers. The lubricating oil for the bearings passes through an oil filter and is controlled by the valve V_2. By changing the speed of the motor which drives the compressor and by operating the valve V_1 the pressure of the oil entering the turbines may be regulated so as to make possible sedimentation measurements at any desired speed between 5,000 and 140,000 r.p.m. The resistance thermometers R_1, R_2, R_3 and the manometers M_1, M_2, M_3 enable the operator to control temperature and pressure in various parts of the machinery.

A detail section of the centrifuge proper through the axis of rotation (with a previous

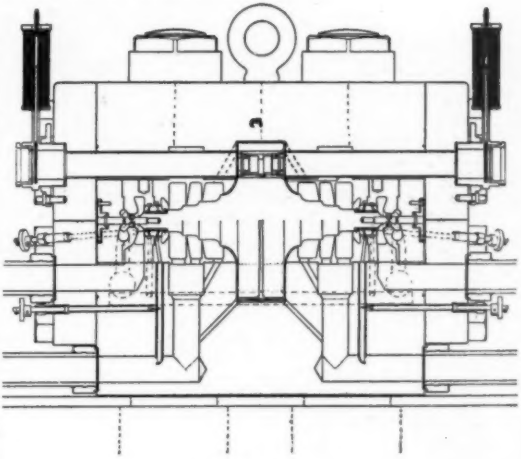


Fig. 3.

Axial section of the oil-turbine ultracentrifuge.

type of rotor) is given in Fig. 3. Fig. 4 shows a picture of it with the upper part of the heavy steel casing lifted, laying bare the rotor and the turbine chambers. The cell with its sector diaphragm is in vertical position upside down. Behind the centrifuge is the lamp house and the light filters. The two halves of the thick steel casing are held together by bolts of chromium-nickel steel firmly anchored in a concrete

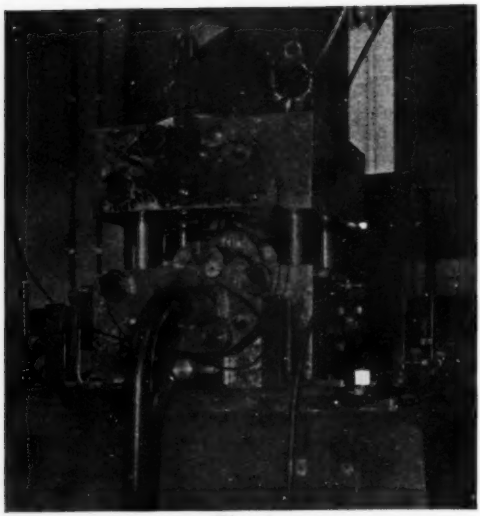


Fig. 4.
The oil-turbine ultracentrifuge with the upper part of the casing lifted.

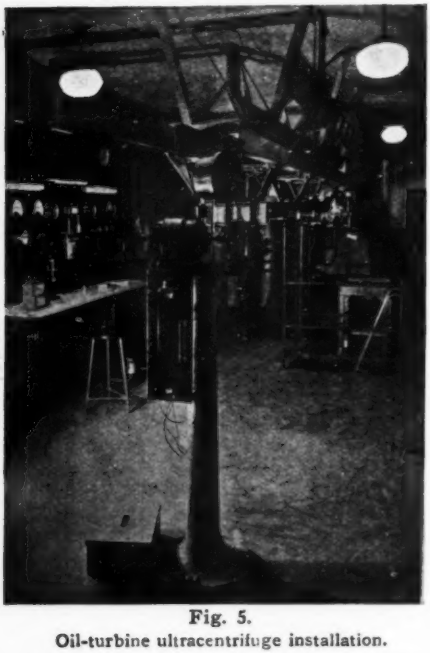


Fig. 5.
Oil-turbine ultracentrifuge installation.

foundation. This arrangement has proved an efficient protection in case of accident (explosion of the rotor caused by overstrain). Fig. 5 gives a total view of the installation showing the stroboscope for measuring the speed, the camera, the centrifuge on its foundation, the oil coolers and, to the left, the switchboard with all the control instruments.

Two kinds of measurements can be done by means of the ultracentrifuge. In the first place, one may centrifuge long enough for a state of equilibrium to be reached between sedimentation and diffusion. Then for each molecular (or particle) species the following formula is valid :

$$M = \frac{2\,RT\,ln\ (c_2/c_1)}{(1-V\rho)\omega^2(x_2^2-x_1^2)}$$

where M = molecular (or particle) weight, R = gas constant, T = absolute temperature, c = concentration of solute, V = partial specific volume of solute, ρ = density of solvent, x = distance from centre of rotation, ω = angular velocity.

In this way one obtains directly the molecular weight. If several molecular species are present in the solution the molecular weight values calculated for different distances from the centre of rotation show a marked drift. Freedom from drift is a criterion of homogeneity with regard to molecular weight.

In the second place one may use a centrifugal field strong enough to cause the molecules or particles to sediment with measurable velocity. This procedure enables

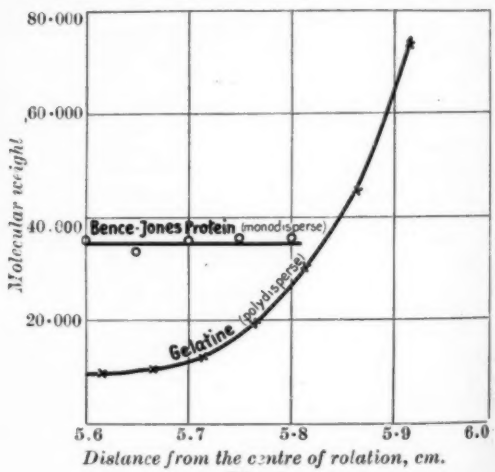


Fig. 6.
Sedimentation equilibrium of Bence-Jones protein (monodisperse) and gelatine (polydisperse).
(B. Sgögren and K. Krishnamurti)

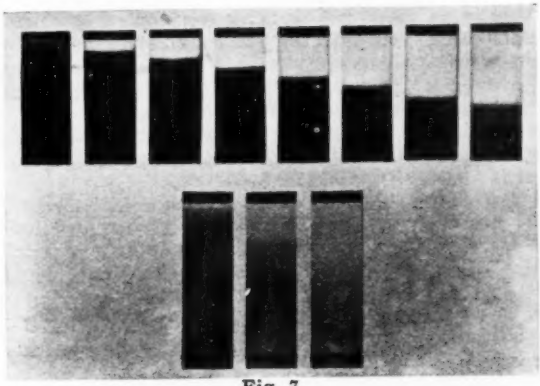


Fig. 7.
Sedimentation of hemocyanin (upper row) and gold colloid (lower row) in a centrifugal field 37,000 times the force of gravity; time between exposures 3 minutes. The former is monodisperse, the latter polydisperse. (E. Chirnoaga and H. Rinde)

Fig. 8.
Sedimentation of hemoglobin in a centrifugal field 900,000 times the force of gravity; time between exposures 3 minutes. (Inga-Britta Eriksson-Quensel)

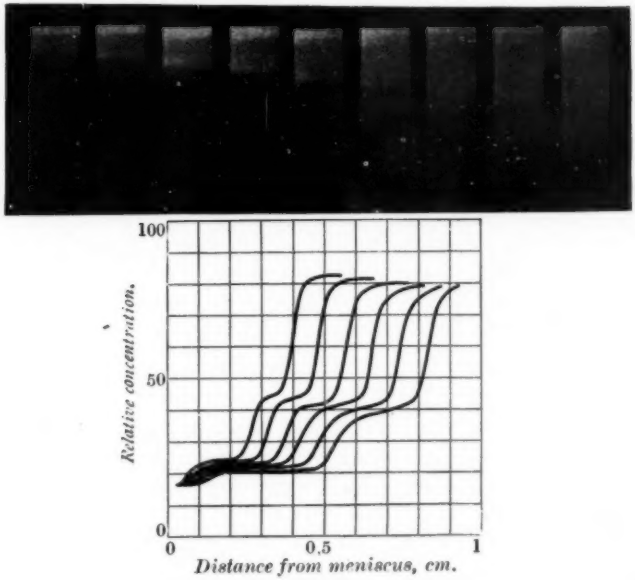


Fig. 9.
Sedimentation analysis of Helix-hemocyanin at the alkaline border of the stability region. Centrifugal field 33,000 g.; time between exposures 5 minutes. (K. O. Pederson)

us to find how many different kinds of molecules are present in the solution. If the sedimentation velocity is referred to unit field and water of 20° C. as solvent, it is called the sedimentation constant. By combining diffusion and sedimentation data the weight of the different molecular species may be calculated according to the formula

$$M = \frac{RT\,s}{D(1-V\rho)}$$

where s = sedimentation constant, D = diffusion constant.

Sedimentation measurements in the ultracentrifuge may also be used for the determination of the weight-distribution or size-distribution of molecules or particles in a polydisperse mixture. The theory being rather complicated we will not go into it on this occasion.

ii.

The ultracentrifuge has a wide range of

application. With the aid of this tool molecular weight determinations have been done from about 10,000,000 (hemocyanin-variety in the blood of the snail Busycon) down to about 40 (lithium chloride). Quite unique is the possibility which this technique offers of carrying out an analysis of the various molecular species or particle sizes present in a solution. The sedimentation constant is a very characteristic molecular

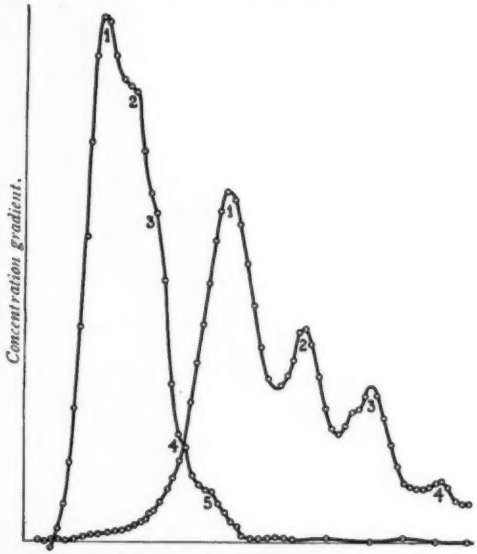


Fig. 10.

Refractometric sedimentation diagram of diluted blood-plasma from a case of myeloma; centrifugal force 260,000 g., time of centrifuging 15 and 60 minutes. (A. S. McFarlane)

property and by means of it, one often finds it possible to follow sensitive aggregation- and dissociation-reactions in biological systems. The combination of sedimentation equilibrium and sedimentation velocity measurements allows of certain conclusions with regard to the shape of the molecules or particles. This is often of importance when investigating high-molecular compounds.

Among the substances studied so far are proteins, polysaccharides, poly-styrols, dyestuffs and other synthetic organic compounds as well as inorganic colloids and inorganic salts.

Some of the main results of the protein investigations may be mentioned. The native proteins are very homogeneous with regard to molecular weight while artificial colloids as well as proteins extracted from the organisms by rough treatment are polydisperse. As an example of a homogeneity test by means of sedimentation equilibrium measurements the diagram Fig. 6 gives the values of the molecular weight as measured at different distances from the centre

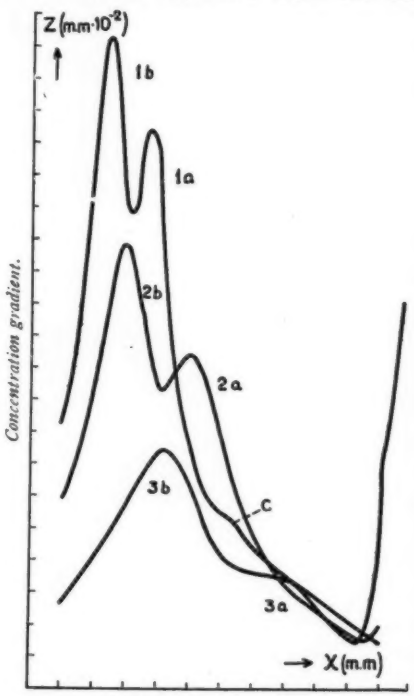


Fig. 11.

Refractometric sedimentation diagram of a solution of starch treated with acid, centrifugal force 145,000 g. (O. Lamm)

of rotation in the case of a homogeneous substance, Bence-Jones protein (B. Sgögren) and an inhomogeneous substance, gelatine (K. Krishnamurti). This is further demonstrated by the sedimentation velocity runs in Fig. 7 which shows in the upper row (E. Chirnoaga) the sedimentation of hemocyanin from the blood of Helix (M = 6,600,000) and in the lower (H. Rinde) the sedimentation of a gold colloid, both of them in a centrifugal field 37,000 g. In the first case the borderline between solution and solvent remains sharp, in the second case it becomes blurred with time because of the different speed with which the gold particles of different sizes are sedimenting. To test the homo-

geneity of a substance of lower molecular weight by a velocity run the centrifugal force has to be increased so as to get sufficient sedimentation before a blurring of the boundary by diffusion takes place. Fig. 8 shows the sedimentation of hemoglobin (M = 69,000) in a centrifugal field 900,000 times the force of gravity (Inga-Britta Eriksson-Quensel). The border-line remains sharp and the protein in question is, accordingly, quite homogeneous.

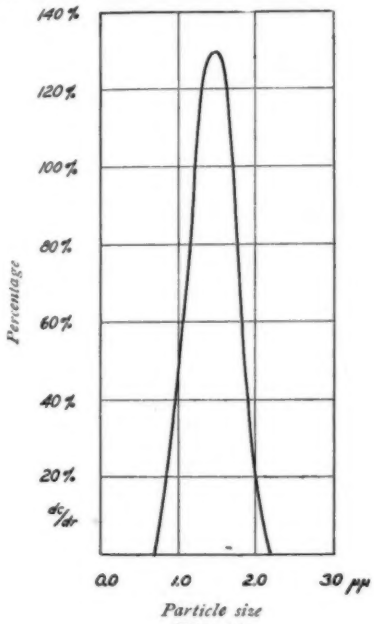


Fig. 12.
Size-distribution in a gold colloid.
(H. Rinde)

The molecular homogeneity of a protein remains unchanged when the pH of the solution is changed within certain limits. At well-defined pH-values changes in the shape or in the weight of the protein molecule take place. Among the hemocyanins a number of reversible dissociation-association reactions have been observed. As an example the behaviour of Helix-hemocyanin at the alkaline stability border may be given. Fig. 9 (K. O. Pedersen) shows the presence of two dissociation products of mass $\frac{1}{2}$ and $\frac{1}{8}$ together with unchanged molecules. A closer study of this phenomenon reveals the fact that the hemocyanin-molecule is at first split into halves and some of these halves into four parts (Inga-Britta Eriksson-Quensel).

In some cases the association state of a protein is dependent on the dilution and on the presence of other proteins. Recent investigations on serum have shown (A. S. McFarlane) that the globulin may appear in molecules of different mass according to the concentration of the albumin present in the serum. Pathological states of the organism bring about characteristic changes in the sedimentation diagram of the serum proteins (Fig. 10), a fact that suggests the use of the ultracentrifuge as a possible instrument for diagnostic purposes.

An ultracentrifugal study of solutions of starch (O. Lamm) has given the following result. Depending on the previous treatment the particle size varies, but always in a continuous way. No distinct molecular species were found. Preparations treated with acid show two maxima corresponding to amylose and amylopectin (Fig. 11). A detailed investigation of the solutions of poly-styrols in various organic solvents has been carried out (R. Signer). The molecules were found to be very elongated and free movement was observed only in very dilute solutions. The viscosity increases with molecular weight. Gold colloids were among the first objects of ultracentrifugal investigations. Fig. 12 shows the size-distribution curve of a very fine-grained gold sol (H. Rinde).

iii.

The utilisation of the ultracentrifuge for the study of high molecular compounds is only at its beginning. As research goes on new problems present themselves for treatment with this new tool. So far the main interest of applications has been in the field of biology and medicine because of the various kinds of new information which the ultracentrifuge has made available with regard to the behaviour of the proteins—those substances of paramount importance to all living beings. But there are also the vast fields of the carbohydrates, the hydrocarbons and the synthetic organic high-molecular compounds. A number of important chemical industries are handling materials belonging to one or the other of these classes of substances. The research laboratories connected with such industries are beginning to realise that the ultracentrifuge may be able to render services of great value in elucidating the properties of the molecules and particles which are the building-stones of cellulose, artificial silk, varnishes, rubber, dyes and many other products,

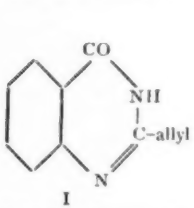
Vasicine.

By K. S. Narang and J. N. Ray.

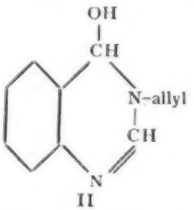
(University Chemical Laboratories, The University of the Panjab, Lahore.)

VASICINE, $C_{11}H_{12}ON_2$, an alkaloid, was isolated from the leaves of *Adhatoda Vasica*, Ness by Sen and Ghosh.[1] It was found to be a monacid base and further studies by Ghosh[2] revealed the presence of a quinazoline ring. With phosphorous penta-chloride, it was converted into chloro-desoxy vasicine indicating that a hydroxy group replaceable by chlorine exists in the molecule. With alkaline permanganate it gave a substance believed to be 4-oxyquinazoline but direct proof of its formation was furnished by Ghosh, Krishna, Narang and Ray.[3] Ghosh[2] was of the opinion that vasicine was 2-propyl 4-oxyquinazoline, a substance which was later on synthesised by De and Ray[4] and proved to be not identical with vasicine. Ghosh, Krishna, Narang and Ray[3] found evidence that vasicine is converted into an isomeric substance by traces of alkali and gave a solid acetyl derivative. But Narang and Ray[5] were of opinion that the isomeric base may be impure vasicine.

In 1934, Späth and Nikawitz[6] were supplied by the firm of E. Merck, a base isolated from the mother liquors of *peganam harmala*. This base melted at a slightly higher temperature because the m.p. was determined *in vacuo*. Its formula was $C_{11}H_{12}ON_2$ but it gave a liquid acetyl derivative and hence the question of its identity with vasicine was left open by these authors. Oxidation with permanganate furnished 4-oxy-quinazoline 3-acetic acid and hence the formula II was advanced by Späth and Nikawitz as



I



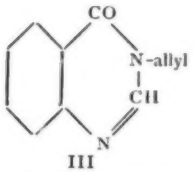
II

against (I) advanced sometime ago for vasicine by Ghosh, Krishna, Narang and Ray.[3] The solubility of vasicine in acetone also differed from the solubility of peganine in the same solvent. Hanford, Liang and Adams[10] showed the solubility of vasicine in acetone to be small as observed by Ghosh, Krishna, Narang and Ray[3] and the greater solubility of peganine must be due to associated impurities.

Narang and Ray[5] criticised the Späth-Nikawitz formula on various grounds and expressed the opinion that vasicine may not after all be identical with peganine because the acetyl derivative has been found by Späth and Nikawitz[6] to be an oil as against the solid dehydro acetyl derivative of Ghosh, Krishna, Narang and Ray.[3]

Späth and Kuffner[7] however definitely established the identity of vasicine and peganine. Reynolds and Robinson[8] suggested that in view of identity of vasicine and peganine, the latter name is redundant. These authors[8] conclusively proved the Späth-Nikawitz formula to be incorrect by synthesising a substance of the structure II by an unambiguous method. Narang and Ray[9] advanced additional evidence against formula II proposed by Späth and Nikawitz.

Narang and Ray[5] synthesised the compound III and proved that its reduction product with sodium and amyl alcohol was not identical with the similar reduction product of vasicine and hence the structure II advocated by Späth and Nikawitz was untenable. In this connection it must be stated that Späth obtained a base $C_{11}H_{16}N_2$ by the reduction of vasicine. It is impossible to get a substance of that formula from vasicine.



III

Narang and Ray[9] then proposed two formulæ—one a cyclic system of three rings and another, an open chain—for vasicine. If the open chain one was the correct representation of vasicine, then in oxidation and other

[1] *J. Indian Chem. Soc.*, 1925, **1**, 315.
[2] *J. Indian Chem. Soc.*, 1927, **4**, 1.
[3] *J. Chem. Soc.*, 1932, 2740.
[4] *J. Indian Chem. Soc.*, 1927, **4**, 541.
[5] *Curr. Sci.*, 1934, **2**, 388.
[6] *Ber.*, 1934, **67**, 45.
[7] *Ber.*, 1934, **67**, 868.
[8] *Nature*, 1934, **134**, 142.
[9] *Chem. and Industry*, 1934, **53**, 698.
[10] *J. Amer. Chem. Soc.*, 1934, **56**, 2780.

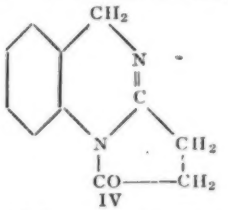
reactions it passed through an intermediate tricyclic stage. They further pointed out that desoxy-vasicine was not identical with 3-allyl 3 : 4 dihydroquinazoline as would be the case if formula II of Späth and Nikawitz was the correct structure of vasicine. Hanford, Liang and Adams,[10] besides supporting Narang and Ray,[9] advanced the additional argument that 3-allyl 4-keto 3 : 4 dihydroquinazoline can be catalytically reduced, whilst vasicine is unaffected. They advanced a cyclic formula for vasicine which is much nearer the truth than the set of random suggestions of Späth and Nikawitz.[6] Moreover the position of the hydroxyl was taken to be in β-position in the third ring whilst actually it is in α-position. It must be stated that Späth and Nikawitz only suggested in their paper all possible variations in which $C_{11}H_{12}ON_2$ can be arranged as a quinazoline and it is not fair to attribute to them the formula that later on was proved to be correct.

Narang and Ray[11] prepared IV and V and found that the electrolytic reduction product of IV was not identical with the similar product from vasicine but the reduction product of V was identical with the reduction product of vasicine. Hence vasicine has a linear cyclic formula. Späth, Kuffner and Platzer[12] synthesised desoxy vasicine from *o*-nitro-benzylamino butyric acid which, on reduction and treatment with phosphoryl chloride, passed into a substance which, on reduction with sodium and amyl alcohol, furnished a product identical with the reduction product of desoxy vasicine. This product is identical with the reduction product of V. Neither the work of Späth, Kuffner and Platzer[12] nor that of Narang and Ray[11] furnishes any proof of the position of the hydroxy group. But Morris, Hanford and Adams[13] furnish an acceptable evidence of the position of the alcoholic hydroxyl group.

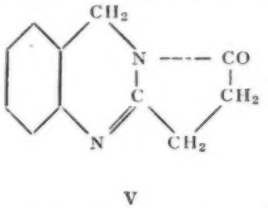
Finally *o*-nitrobenzyl chloride on condensation with α-hydroxy-γ-aminobutyrate furnished a product which was cyclised, after reduction to a substance identical with vasicine, by Späth, Kuffner and Platzer[14] and hence vasicine becomes VI. It will be seen that the hydroxyl group is attached to the α-position and is not in the β-position, where it figures in the various formulæ proposed by Späth and Nikawitz.[6]

Späth, Kuffner and Platzer[15] now find that vasicine gives a solid acetyl (dehydro) as stated by Ghosh, Krishna, Narang and Ray.[3] Narang and Ray[5] based their view of non-identity of vasicine and peganine on Späth's reporting the acetyl derivative to be a liquid.

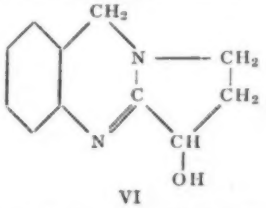
Späth, Kuffner and Platzer[16] have resolved vasicine into optical enantromorphs but since natural vasicine is a *dl* compound, this paper has no bearing on the constitution of vasicine. But Ghosh, Krishna, Narang and Ray have already stated that vasicine is resolvable, a fact which Späth, Kuffner and Platzer have acknowledged.



IV



V



VI

[11] *Curr. Sci.*, 1935, **3**, 352.
[12] *Ber.*, 1935, **68**, 497.
[13] *J. Amer. Chem. Soc.*, 1935, **57**, 921 and 951.
[14] *Ber.*, 1935, **68** (B), 702.
[15] *Ber.*, 1935, **68** (B), 935.
[16] *Ber.*, 1935, **68** (B), 1386.

A Ram Sarcophagus from Cuddapah.

By M. D. Raghavan, M.A., *Government Museum, Madras.*

THE terra-cotta sarcophagus illustrated was unearthed at Sankavaram, a small village about two miles north of the town of Porumamilla, in February 1935, in the Badvel Taluk of Cuddapah District, in the course of digging for the foundations of a new church. The discovery was brought to the notice of the authorities of the Madras Museum by the Bishop of Dornakal. The sarcophagus and the associated pottery were carefully preserved by the parson, Rev. Christudary, at the S.P.G. Parsonage at the adjoining village of Markapuram, until I took charge of them, and removed them to the Museum in May last. The objects were exhibited before a meeting of the Archæological Society of South India at Madras in June, and evoked considerable interest.

The human character of the interment which the sarcophagus contained is not open to doubt as is evident from the skeletal remains. There is no charring of the bones which are so much decayed that they have turned completely white.

The sarcophagus is of unique interest in that it is in the shape of a ram. The ram's head is clearly modelled, the curling horns being emphasised, and the ears omitted. The only other funerary vessel in animal form known from South India is a small-sized urn from the left bank of the Tungabhadra river, with a rounded body, and column-shaped legs, which suggested to Bruce Foote an elephantoid form.[1] Its head part was, however, not found and in the absence of this part the identification of an elephantoid form cannot be definite.

The trunk of the ram is so modelled that the lower part of it, supported by the legs, forms the receptacle for the bones, and the upper part forms a lid. This upper part is modelled in two pieces, the section in front ending in a well-arched neck, at the apex of which is a wide aperture. About half way from the top a hole is placed symmetrically on either side of this section. The portion of the lid behind is well rounded, and is so modelled as to simulate the hind part of an animal, which only lacks the tail to complete the picture.

Elaborate decoration with impressed rope-work design is a feature of the object, the decoration extending all around the borders, and running longitudinally along the central line of the lid from the neck to the hind quarters. The character of this decoration is suggestive of the trappings of an animal caparisoned for riding.

For the proper understanding of the probable significance of the ram form, we have to take note of the vast complex of ideas associated in the mind of primitive man with the animal kingdom. The domestication of animals fostered a feeling of kinship, and greatly influenced primitive man's attitude towards death. Certain animals came to be regarded as embodiments of the souls of the dead, and the ram often served as one such soul-animal. The sheep was the object of special rites with all pastoral peoples: it entered so much into the life of all early peoples that it was the chosen animal to bear all the sins and evils of mankind as the goat was among the Jews.

With the idea of the ram as a soul-animal, which has the soul of the deceased in its keeping, is possibly linked the idea of its acting as a convoy in transporting the soul to the spirit world, an idea which is suggested by the decorative trappings of the ram as if caparisoned for riding.

Of obvious significance in this connection is the position assigned to the ram in the hierarchy of the gods of early Indian faith.

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[1] Bruce Foote, "Indian Pre-historic and Proto historic Antiquities—Notes on their Ages and Distribution," 185-86.

A deity invoked as early as the Rig Vedic times for obtaining a son was Naigamēsha. In the medical treatises, Naigamēsha is, however, a ram-faced demon causing children's diseases. Offerings to the ram-faced god are among the remedies prescribed for such diseases. This association of two opposite ideas—that of a deity dangerous to children, and of a deity helpful in the procreation of children, is interesting.[2] The enclosing of the bones of the deceased within a ram-faced sarcophagus would seem to suggest a request to Naigamēsha to ensure that the deceased might through his influence be born back on earth.

The clay sarcophagus lay at a depth of about 6 feet below ground level. Perhaps the most conspicuous feature of the land is the abundance of rounded pebbles and boulders strewn about the place, indicative of considerable surface denudation. Situated in the slope of the valley formed by the spurs of the Eastern Ghats, the place has apparently witnessed considerable changes in climate. The geology of the country is a matter for further investigation.

The associated finds are two pieces of iron objects—a spear head and a fragment of a knife or sickle—both found inside the sarcophagus highly corroded; and an interesting series of pottery, a squat type of vessel with shield-shaped back, and shallow all-black pans predominating. The pans are highly polished and some bear spiral marking inside.

The ram sarcophagus is also interesting for the evidence it gives of the early domestication of sheep in this part of South India, where sheep farming is still a most flourishing industry.

[2] Prof. M. Winternitz in *J.R.A.S.*, 1895, pp. 145-155; Bühler in *Epigraphia Indica*, **11**, pp. 314-18.

Diwan Bahadur Sir T. Vijayaraghavacharya.

THE retirement of Diwan Bahadur Sir T. Vijayaraghavacharya on October 25th after a short period of leave, marked the completion of a long and distinguished record of Government service. The Diwan Bahadur was born at Karur in 1875 and entered the Madras Civil Service in 1898 so that he has 37 years of service to his credit. He rapidly made his mark as a district officer and the intimate knowledge of village life then gained has stood him in good stead. His first administrative post was with the Madras City Corporation from 1912 to 1917. After a period as Secretary to the Board of Revenue, which gave him a further insight into revenue administration, he was Diwan of the Cochin State in 1919 till 1922. The Diwan Bahadur first became known to most people in other parts of India as Commissioner for India at the British Empire Exhibition, Wembley—a task which occupied him from 1922 to 1925 and where his great organising ability had full scope. His distinguished services to India and the Empire were appropriately recognised in 1926 when the Knighthood of the Most Excellent Order of the British Empire was conferred upon him by His Majesty. On return to India, he became Director of Industries, Madras, for a short period but was very soon appointed as Member of the Public Service Commission when that body was first constituted. When Sir Vijaya became the first Vice-Chairman of the Imperial Council of Agricultural Research in 1929, he possessed in full measure the qualifications laid down as essential for the Council's principal administrative officer by the Royal Commission on Agriculture. An agriculturist and landowner by birth and tradition with long and varied administrative experience, he was able to appreciate all points of view and displayed great skill in the conduct of debates which were frequently highly technical in character. As a Chairman, his impartiality and never-failing good humour were coupled with the gift of accelerating business. Outside the formal meetings, his relations with all members of the Research Council and his staff were most happy. Not only did he promote co-operation within the Council but he made its aims, objects and work well known throughout India and secured for it a wide measure of unofficial support. During the period of retrenchment and financial stringency, which overtook the Council early in its career, his sustained optimism and constant advocacy of the fundamental importance of agricultural research to the well-being of the Indian nation were invaluable. That the Imperial Council of Agricultural Research has been able to go as far as it has in the direction of fulfilling the intentions of its distinguished

founders is due in no small measure to the personality of its first Vice-Chairman. He did much to bring the Research Council into touch with the Indian Universities. He was an active member of the Indian Science Congress, over the Agricultural Section of which he presided in 1930, and he became a foundation Fellow of the National Institute of Sciences of India on the formation of that body in January 1935. Scientific workers in all subjects found in him a sympathetic and understanding listener. In later years Sir Vijaya was a great traveller. His duties as Commissioner for the Wembley Exhibition took him all over India as well as to England. In 1926 he opened the Canadian National Exhibition at Toronto and gained many friends in that Dominion. In 1930 he led the Indian Delegation at the General Assembly of the International Institute of Agriculture and visited Europe again early in 1932. In the following year he gave evidence before the Joint Parliamentary Committee on the Government of India Bill and he made another flying visit to England and the Continent in 1934. In India he toured freely on the Council's business. The Diwan Bahadur is now enjoying a well-earned holiday in England but has by no means abandoned his interest in Indian agricultural affairs. Fortunately neither the Imperial Council of Agricultural Research, nor the Indian Central Cotton Committee, of which he was Chairman for six years, will lose the benefit of his experience for the Government of India have appointed him, by name, as a member of both these organisations. His many friends in Simla, Delhi and South India can wish him a happy period of retirement in the full knowledge that his active and versatile mind will still be fully occupied for the benefit of his country.

B. C. B.

SANDALWOOD—Hawaii's Most Valuable Tree.

SANDALWOOD, theme of a thousand romances and poems of early commerce, is being groomed for a comeback in the forests of Hawaii. It once existed there in great quantities, but over-exploitation 125 years ago by an alliance of traders and native potentates almost wiped it out.

The forests were devastated at that time because of the high prices that could be secured in China for this sweet-scented wood. They promise to be re-established because that price still maintains.

C. S. Judd, territorial forester, some years ago secured from Mysore (India), seeds of what is held to be the most valuable species of sandalwood. He planted these seeds on a ridge in the suburbs of Honolulu and they grew abundantly. To-day there are some 1,500 three-year-old trees on this ridge. They are bearing all the seed that is needed for nursery use. Apart from these, an old sandalwood tree is occasionally found in some remote mountain canyon.

In the pots at the nurseries in Hawaii ironwood seeds are planted with the sandalwood. In its native state the sandalwood always grows among other trees and helps itself to aid from their roots, as a partial parasite. On the ridge that overlooks Honolulu where 1,500 young trees are growing vigorously they stand among lantana bushes, members of the verbena family.

Sandalwood trees grow rather rapidly. They are of some value at the age of 25 years. It is the heart of the tree, however, that is most precious, and heart-wood is not likely to develop greatly until the tree is 40 or 50 years old. Since the present plantings are chiefly in territorial forests, however, the profits do not need to be immediate to make the enterprise sound.

—*Science*, 1935, **82**, No. 2129, (Supplement, p. 7).

Letters to the Editor.

CONTENTS.

The Raman Spectrum of Crystalline Selenious Acid.

PRINGSHEIM AND YOST[1] studied the Raman effect in an aqueous solution of selenious acid (H_2SeO_3) and recorded two broad and fairly intense lines of frequency shifts 695 and 885 cm^{-1}. I have recently investigated this substance in the form of transparent crystals and obtained a very intense spectrum at an exposure of about four hours which consists of a large number of sharp lines. The photograph of the spectrum is reproduced in Fig. 1. The frequency numbers of these lines in cm.$^{-1}$ are 840 (1), 909 (2), $\overline{888}$ (10), $\overline{862}$ (0), 706 (3), $\overline{597}$ (8), 524 (3), 364 (0), $\overline{299}$ (2), $\overline{287}$ (3), $\overline{254}$ (6) and $\overline{199}$ (3). The numbers within the brackets indicate the relative intensities of these lines and a dash above some of them shows that their anti-stokes are also present. These lines have been obtained with 4046 and 4358 radiations of the mercury arc with equal intensity.

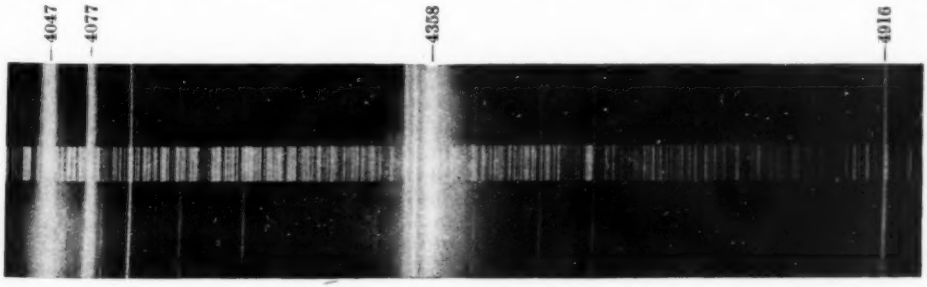


Fig. 1.

The spectrum of the solid is thus markedly different from that of the aqueous solution of this acid and resembles, in its general features, the anomalous behaviour observed by me in the iodic acid.[2] The detailed investigation of this acid as well as the selenic

acid as solid and solutions of different concentrations and their salts is under progress and a full report of the results and their significance in relation to their structure and electrolytic dissociation will appear in the *Proceedings of the Indian Academy of Sciences*.

C. S. VENKATESWARAN.

Department of Physics,
Indian Institute of Science,
Bangalore.
October 31, 1935.

[1] Pringsheim and Yost, *Z. Physik.* 1929 **58**, 1.

[2] Venkateswaran, C. S., *Proc. Indian Acad. Sci.*, 1935, **2A**, 119.

Determination of the Time of Setting of Gels.

SEVERAL methods have been employed to determine the time required for the setting of a silicic acid gel. Fleming[1] determined it by the criterion that the gel does not flow out of the test tube when it is inverted. Fells and Firth[2] measured it by the maximum pressure required to blow a bubble of air, mercury or chloroform through the gel-forming mixture. Prasad and Hattiangadi[3] noted the intensity of light transmitted through a gel-forming mixture by means of a thermopile connected to a sensitive galvanometer and read the time of setting from the time-deflection curve. Similar methods have been employed by Mardles[4] and by Aritsz.[5] Hurd and Letteron[6] considered the gel to have set when a small glass rod placed at an angle of 15°–20° in the gel-forming mixture remained in position.

Fleming's method has been compared with the optical method by Prasad and Hattiangadi[7] who showed that the time of setting obtained by the former method is less than that obtained by the latter. The results obtained by optical method have now been compared with those obtained by the Bubble and the Rod methods, respectively. It may be mentioned that mechanical devices were employed for the determination of the time of setting by the latter methods in order to disturb the gel-forming mixtures as little as possible.

The gels were prepared by mixing solutions of sodium silicate and hydrochloric acid. The results given in the following Table show that the Bubble method gives the least and the optical method the highest value for the time of setting.

TABLE I.

N	C = 9·8 per cent.			C = 12·1 per cent.		
	I	II	III	I	II	III
0·5	87′-30″	78′-0″	101	137	120	152
0·6	35′-0″	24′-0″	48	39	27	65
0·7	2′-50″	1′-40″	10	3′-15″	2	15

N and C are, respectively, the normality of HCl and the silica content of the gel-forming mixture and I, II and III, the time of setting in minutes by the Rod, Bubble and Optical methods, respectively.

It will be seen that Fleming's, the Rod and the Bubble methods depend upon the attainment of a certain viscosity value, different from each other, by the gel-forming mixture. The observed differences in the time of setting by the Bubble and the Rod methods are due to the fact that greater viscosity is required to prevent a glass rod from falling from a certain position than that needed to prevent the blowing of bubbles of a gas or a liquid, which are very elastic, through the gel-forming mixture.

It appears, therefore, necessary to define the term "time of setting of a gel" before applying any method for measuring the same. It is now fairly well established that the process of gelation includes (i) the formation of the colloidal solution of the gelling substance, (ii) its coagulation, hydration and agglomeration, and (iii)the formation of the specific structures; other structural changes which eventually take place such as synersis, etc., can be neglected. A gel should, therefore, be considered as set only when all the three processes mentioned above are complete and not when the gelling substance has gone through a certain part of the increased hydration and the increased viscosity of the second process. In such a case a method such as the optical method which takes into account all the changes which the gel-forming mixture undergoes during gelation, should give a reliable value of the time of setting of the gel. The application of such a method will, of course, be limited to those gel-forming mixtures which are clear before gelation starts and continuously change in transparency till all the

changes involved in the setting of a gel are complete.

MATA PRASAD.
M. U. PARMAR.

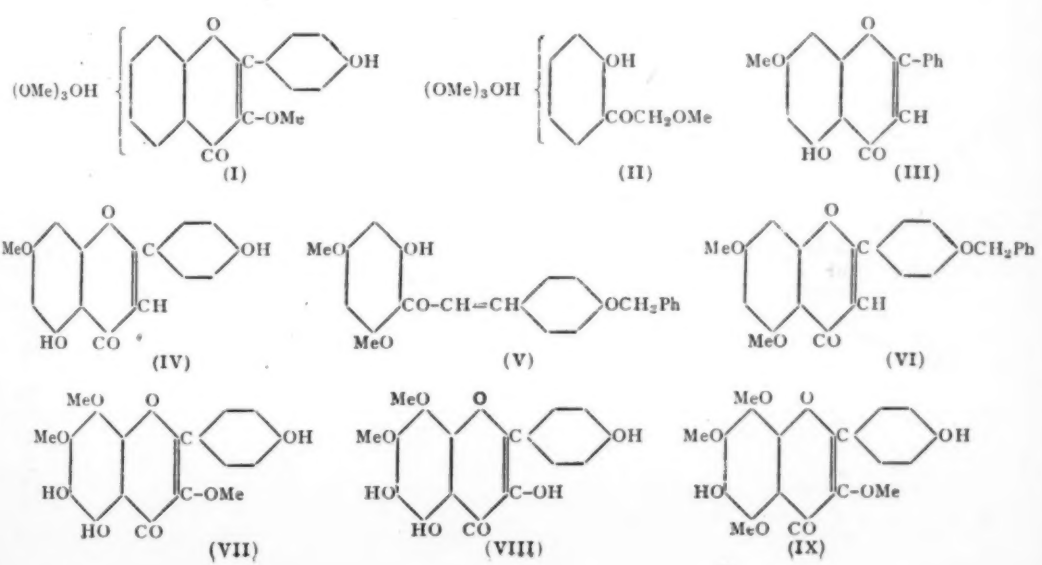
Chemistry Laboratories,
Royal Institute of Science,
Bombay,
October 29, 1935.

1 Fleming, *Zeit. Phys.*, 1902. **41**, 427.
2 Fells and Ferth, *Trans. Farad. Soc.*, 1927. **23**, 25.
3 Prasad and Hattiangadi *J. Indian Chem. Soc.*, 1926, **6**, 659.
4 Mardles, *Trans. Farad Soc.*, 1923. **18**, 318.
5 Aritsz. *Kolloid Chem. Beih.*, 1915. **7**, 14.
6 Hurd and Letteron, *J. Phys Chem.*, 1932.
7 Prasad and Hattiangadi, *loc. cit.*

The Constitution of Calycopterin.

THE anthelminthic constituent, *calycopterin*, of the leaves of *Calycopteris floribunda*, Lamk., has been shown[1] to be a dihydroxy-tetramethoxyflavone and to be identical with the yellow colouring matter isolated by Karrer[2] as a bye-product in the preparation of digitoxin from the leaves of a Spanish *Digitalis*.[3] On fusion with alkali calycopterin gave *p*-hydroxybenzoic acid and the stability of an alkaline solution of the substance to oxidation by atmospheric oxygen pointed to a methoxyl in the 3-position. Calycopterin was represented as (I); with the limited amount of material available the identification of the water-soluble phenol obtained in the course of the degradation with alkali was not practicable; isolation of the phenol in quantity and the orientation of the two hydroxyls and three methoxyls would in any case be extremely difficult in the case of a pentahydroxybenzene derivative. Repeating the alkaline hydrolysis we have now prepared the ketone (II), the colour reactions of which, however, failed to give a definite indication of the position of the hydroxyl in the fused benzene ring of the flavone.

In a recent communication[4] to the *Journal of the Chemical Society* we have reported the demethylation of 5-methoxyflavones to 5-hydroxyflavones by means of aluminium chloride; under prescribed conditions the methoxyl in the 5-position is preferentially attacked and the method may be utilised for the synthesis of partially-methylated polyhydroxyflavones such as tectochrysin (III) and genkwanin (IV). The synthesis of the latter on these lines has just been completed and will be reported elsewhere; the oxidation of the chalkone (V) with selenium dioxide[5] gave the flavone (VI), which was successively debenzylated and demethylated to genkwanin (IV). In the course of this work it was apparent that the action of aluminium chloride on a methoxyflavone might be fruitful as a diagnostic test for the presence of a methoxyl in the 5-position; its application to the specific instance of calycopterin has revealed the position of the



hydroxyl in the fused benzene ring. The treatment of calycopterin with aluminium chloride has resulted in a new flavone, which exhibits the usual properties of a catechol derivative, *e.g.*, the characteristic red-brown colouration with ammonium molybdate and acetic acid,[6] and must therefore be 5 : 6 : 4′-trihydroxy-3 : 7 : 8-trimethoxyflavone (VII) or 3 : 5 : 6 : 4′-tetrahydroxy-7 : 8-dimethoxyflavone (VIII); the second alternative needs to be considered since we have noticed that a 3-methoxyl is also susceptible to demethylation by aluminium chloride. The second hydroxyl in calycopterin being in the 6-position, calycopterin may now be formulated as 6 : 4′-dihydroxy-3 : 5 : 7 : 8-tetramethoxyflavone (IX).

H. S. MAHAL.
K. VENKATARAMAN.
Royal Institute of Science, Bombay,
Department of Chemical Technology,
The University, Bombay,
October 19, 1935.

[1] Ratnagiriswaran, Sehra and Venkataraman, *Biochem. J.*, 1934, **28**, 1964.
[2] Karrer, *Helv. Chim. Acta*, 1934, **17**, 1560.
[3] Karrer and Venkataraman, *Nature*, 1935, **135**, 878.
[4] Compare also Bharadwaj and Venkataraman, *Curr. Sci.*, 1933, **2**, 50.
[5] Mahal, Rai and Venkataraman. *J. Chem. Soc.*, 1935, p. 866.
[6] Quastel, *Analyst*, 1931, **56**, 311.

Condensation of ω-Bromoacetophenone with 1-*o*- Aminophenyl-3-Phenylthiocarbamide.

THE condensation of ω-bromoacetophenone with 1-*o*-aminophenyl-3-phenylthiocarbamide yielded a compound (m.p. 230° decomp.; empirical formula $C_{15}H_{13}ON_2SBr$) to which a heptathiodiazine structure was assigned by me.[1] Pathak[2] has obtained, by carrying out the same condensation, a compound (m.p. 223° decomp.) possessing the same empirical formula and finds that it is the hydrobromide of a weak heterocyclic base. These two compounds have been regarded by him as identical.

That the compound (m.p. 230° decomp.) isolated by me is not the hydrobromide of a heterocyclic base but possesses the heptathiodiazine structure is definitely proved by the fact that it is, as already mentioned in my original paper, acidic in nature being soluble in cold dilute alkali and precipitated by acids. This property, *viz.*, that the compound is unaffected by sodium bicarbonate solution and is precipitated *unchanged* by acid from its solution in alkali, has been again established and dispels any idea of the compound being a hydrobromide. The compound melts with decomposition to form a dark brown viscous liquid which emits smell of ω-bromoacetophenone.

In view of the properties of my compound as mentioned in my original paper, it is really surprising how Pathak could regard the two compounds as identical, and his conclusion seems not to be well founded. From Pathak's observations, it seems very probable that his compound is entirely different from mine and slight difference in experimental conditions employed by him may account for the formation of a different compound.

My compound (m.p. 230° decomp.) can be prepared as follows: An intimate mixture of the reactants (equimolecular proportions) is mixed, at ordinary temperature, with glacial acetic acid and shaken, when a clear solution is obtained accompanied by rise in temperature. In about an hour a solid is precipitated which after precipitation from an alkaline solution by acid is crystallised twice from glacial acetic acid in colourless needles.

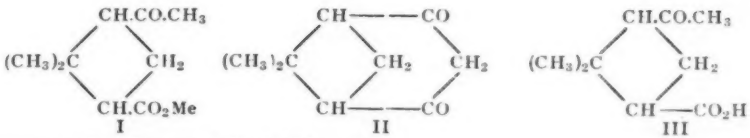
Pathak's further observation by way of comparing the chemical characteristics of both the compounds seems to be desirable.

TEJENDRA NATH GHOSH.
Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
September 18, 1935.

[1] T. N. Ghosh *J. Indian Chem. Soc.*, 1931, **8**, 71.
[2] Pathak, *J. Indian Chem. Soc.*, 1935, **12**, 463.

Synthesis of "Ketonopinone" (4 : 6-Diketonopinane).

THE synthesis of pinononic acid (III) and its methyl ester (I) starting from *cis*norpinic anhydride has been reported by us.[1] The conversion of (I) into ketonopinone (II) has now been effected by means of sodium in toluene or sodium methoxide in alcohol solution. Ketonopinone (II), m.p. 104°, purified through its copper derivative (sint 238°) gives a violet coloration with $FeCl_3$, dissolves in sodium bicarbonate, decolourises alkaline permanganate and absorbs bromine in chloroform solution. The constitution was confirmed by hydrolysing it with baryta to pinononic acid (III). Reduction of this diketone to nopinone and nopinane is in progress.



It can now be observed that this constitutes a *total* synthesis of a bicyclic compound in the pinane group; Ruzicka's synthesis of pinocamphone, α- and δ-pinenes[2] involved the use of pinonic acid yet unsynthesised. Work on the synthesis of pinonic acid starting from norpinic acid is in progress.

Full details will shortly be published elsewhere.

P. C. GUHA.
K. GANAPATHI.

Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
November 2, 1935.

[1] *Curr. Sci.*, 1935, **3**, 484.
[2] *Helv. Chim. Acta.*, 1920, **3**, 756; 1924, **7**, 489.

A Manometric Device for Gas Analysis.

FOR the quantitative measurement of the respiratory gaseous exchange in plants Haldane's gas-analysis apparatus is generally used. The apparatus is undoubtedly highly accurate but requires considerable skill before it can be used with discrimination. The construction of the apparatus is complex and an accidental breakage in the glass parts is not easily repaired. In the course of some physiological investigations connected with the Fruit-Preserving and Fruit-Canning industries where a high degree of accuracy is by no means essential, the need was felt for simple and effective means of gas analysis. With this object in view a simple apparatus for gas analysis was constructed in this laboratory and has been in use for some time with satisfactory results. Over the existing forms of the gas-analysis apparatus, it possesses the following advantages: (1) Sampling the gaseous mixture is exceedingly easy. (2) The use of phosphorus[1] as an absorbent for oxygen instead of potassium pyrogallate obviates the necessity of keeping the gaseous sample in a state of continuous agitation which is often very tiring.

The principle of the apparatus (Fig. 1) consists, in brief, in measuring the pressures exercised by the various constituents of a gaseous mixture. As the partial pressure

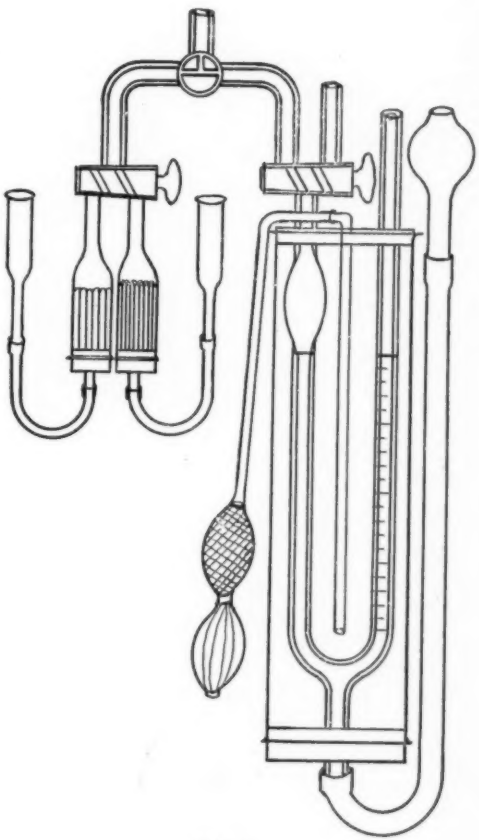


Fig. 1.
A manometric device for gas analysis.

of a component is proportional to its concentration in the gaseous sample and the sum of the various partial pressures is equal to the total pressure exerted by the gas sample, the percentage content of the component, say x, is easily computed:—

$$x = \frac{h \times 100}{H_0}$$

where h = the partial pressure of the component under consideration, and H_0 = atmospheric pressure in mm. Hg.

A detailed description of the apparatus will appear elsewhere.

B. N. SINGH.
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Laboratories for Plant Physiology,
Institute of Agricultural Research,
Benares Hindu University.
July 23, 1935.

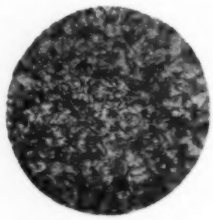
[1] Carpenter, *Carnegie Inst. Wash. Pub.*, 1915, **216**, 76.

Uric Acid Crystals in the Blood Plasma of a Fowl suffering from Pyo-nephrosis consequent on Vitamin A Deficiency.

AN investigation is being undertaken on the growth of embryonic tissues in vitro on plasma taken from vitamin A deficient fowls and rats. In the course of the investigation blood was taken from a fowl which had been fed for 12 weeks on the following diet :—

Milled Rice	.. ..	65 parts.
Ground Whole Rice	..	15 ,,
Casein ..	.. ..	12 ,,
NaCl ..	.. ..	1 ,,
$CaCO_3$ ..	.. ..	1 ,,
$Ca_2H_2(PO_4)_2$	.. ..	1 ,,
Dried Yeast	.. ..	5 ,,

Under light ether anæsthesia blood was drawn from the carotid artery. Directly after centrifuging the plasma appeared quite clear. In spite, however, of the fact that the blood was drawn through an ice-cold paraffined canula into a paraffined centrifuge tube and kept in ice packing until centrifuging, clotting occurred within a few minutes of centrifuging. The plasma of a normal fowl, collected and treated in this manner, can be kept in cold storage for months without clotting. In the present instance it was observed that the serum exudating from the clot was turbid and under the microscope it was found to contain a mass of needle-shaped crystals (see accompanying microphotograph, magnification × 103). A post-mortem examination of the fowl revealed that the kidneys were completely disorganised, being practically "bags of pus". The comb showed dryness and keratinisation, and, in places, ulceration. The liver was found to be devoid of vitamin A by the arsenic trichloride test.



Microphotograph of crystals. × 103.

The condition of the kidneys suggested that crystals in the blood might be uric acid. Under the microscope it was observed that they dissolved completely in dilute potassium hydroxide, but were insoluble in dilute acetic acid and in distilled water. A quantitative estimate of uric acid content was made by Benedict's method. For purposes of comparison, similar tests were carried out on the plasma of 2 fowls, with apparently normal kidneys, fed respectively on the mixed stock diet and on a "control" diet similar to the one described above except that it contained 3 per cent. of cod liver oil. Results were as follows :—

	Uric acid in plasma (mgrms. per 100 c.c.)
Fowl on stock diet ..	12·50
,, "control" diet ..	8·34
,, vit. A deficient diet	375·00

There seems no doubt that the crystals were uric acid. A uric acid plasma content about 30 times greater than values obtained from two fowls with normal kidneys, seemed sufficiently interesting to report. The presence of excessive uric acid in the blood was not, of course, directly due to vitamin A deficiency, but was caused by a pyo-nephrosis consequent on vitamin A deficiency. It need hardly be said that the plasma from the deficient bird, choked with uric acid crystals, could not be used for tissue-culture experiments.

Thanks are due to Dr. W. R. Aykroyd, Director of the Laboratories, for permission to publish this letter.

G. SANKARAN.

Nutrition Research Laboratories,
I. R. F. A., Coonoor,
October 22, 1935.

Fusarium Wilt in Sann Hemp.

IN his recent work[1] Mitra brought forth evidence that under the conditions at Pusa wilts in *Crotalaria juncea* and in *Cajanus indicus* are caused by similar physiologic strains of *Fusarium vasinfectum*. Although the isolates from these two hosts were able to cross inoculate each other, they always failed to infect cotton and *vice versa*.

In their study of the Fusarium wilt in sann hemp, the results of which will be published separately, the present writers had obtained evidence that *Fusarium vasinfectum* was a highly specialised species and in no case did the form on sann hemp pass to pigeon pea, and *vice versa*. These results were contrary to those reported by Mitra, and it was therefore decided to test the correctness of Mitra's conclusions by a series of well-designed experiments. Cultures of *Fusarium vasinfectum* from sann hemp and pigeon pea grown in Pusa and in its neighbourhood were secured through the kindness of Dr. Mitra, and were compared with similar cultures obtained locally. The seeds of a wilt-resistant type, T. 89, and of a susceptible type, T. 5, of pigeon pea were also secured from Pusa.

Cross inoculation experiments were made in soil temperature tanks of Wisconsin type at 28° C., the optimum temperature for the development of wilt. In all cases seeds of sann hemp and pigeon pea were surface-disinfected before sowing in pots. In these experiments cultures of *Fusarium vasinfectum* from sann hemp did not infect pigeon pea and *vice versa*, although control plants in all cases gave a high percentage of deaths. These results will be reported in detail separately.

B. N. UPPAL.
N. T. KULKARNI.

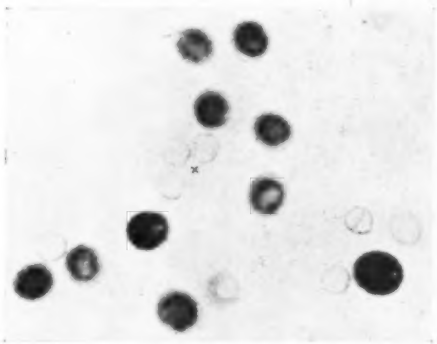
College of Agriculture,
Poona,
November 6, 1935.

[1] Mitra, M., *Ind. Jour. Agric. Sci.*, 1934, **4**, 701–714.

Dummy Pollen.

In the course of the examination of innumerable pollen grains in many varieties of *Sorghum* since 1931, a peculiar kind of pollen was met with. An examination of pollen grains under the microscope shows constantly a few grains devoid of solid contents (see Figure). In size they are comparatively small (31 μ to 34 μ). Due to the pressure of the sap inside, they are not shrivelled but retain normal shape. They do not germinate and usually plasmolyse in the culture medium. Pollen studies have not, so far as we are aware, recorded non-germinating pollen of this peculiar type. Similar pollen has been met with in the allied wild grasses, *Andropogon annulatus* and *Andropogon pertusus*, L. In the eight different varieties of *Sorghum* examined, the incidence of this pollen ranged from 2·3 to 13·5 per cent. In the day flowering *S. margaritiferum* it was only 0·4 per cent. The higher types of cultivated *Sorghum* had a lower percentage of this Dummy Pollen. Dummy Pollen is slightly less in the anthers at the base of the earhead.

In the other millets this pollen is met with in *Pennisetum typhoides*, Stapf and Hubbard (also a millet of African origin), which like



× Dummy pollen in *Sorghum*. × 150.

Sorghum has both hermaphrodite and antheriferous flowers. Instances have been met with in both *Sorghum* and *Pennisetum* in which a non-dehiscence of anthers proved to be due to an extreme paucity of this Dummy Pollen, it being under one per cent. in the non-dehisced ones, and over seven per cent. in the dehisced ones. This points to the probable rôle of this Dummy Pollen as a specialisation ensuring dehiscence in these predominantly night-flowering millets. An experience has been met with in which this poverty of Dummy Pollen and the attendant non-dehiscence of anthers proved a simple recessive to the presence of the normal proportion of such pollen and the consequent dehiscence of anthers. A fuller account of this experience is being published elsewhere shortly.

G. N. RANGASWAMI AYYANGAR.
V. PANDURANGA RAO.

Millets Breeding Station,
Coimbatore,
October 19, 1935.

Forked Awns and Leaf-Blades in Sorghum.

AMONG cereals, maize and sorghum have big leaf-blades. These blades have an entire margin and a single central, well-marked midrib running their entire length. This midrib occasionally forks into two

Fig. 1.

(G. N. Rangaswami Ayyangar and P. Subramanyam, 1930).[1] A second aberration in the leaf-blade of sorghum has been met with in some selections. This occurred in three single plant selections from a variety from Bihar (India) and in five single plant selections taken from Kafir imported from America. The aberration is a disturbance in the entirety of the margins of the leaf. In the two halves of the blade there appear deep marginal indentations giving the leaf a tri-dentate appearance (Fig. 1).

Forking occurs usually in the apical third of the leaf, sometimes in the middle third and rarely in the basal third. It forks usually in one leaf of the adult plant and rarely in two leaves. In one instance three leaves in a plant manifested this forking. The forking may show in any leaf of the plant from the flag downwards. It tended to show a little more frequently in the eighth or ninth leaf from the top. Leaves of side-shoots may also fork. In the population examined, 5–13 per cent. of the plants in Kafirs and 26, 30 and 32 per cent. in the three Bihar families manifested forked leaves.

Of the eight families, the five Kafirs were awnless. The three Bihar pure lines were awned. An examination of the awns showed that in every ear-head some of the awns forked in degrees. Ten ear-heads were examined in detail and each ear-head had an average of 1350 awns. Of these an average of 8 proved to be forked awns (Fig. 2). The forking varied from a slight

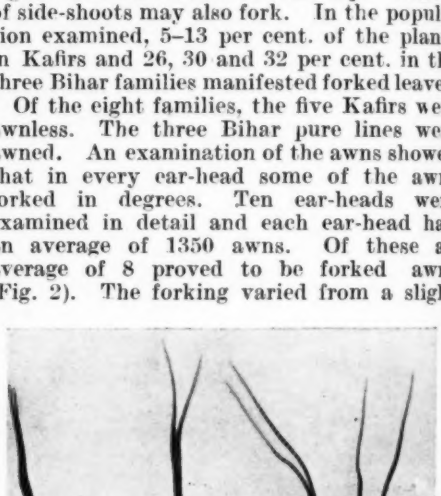


Fig. 2.

bifurcation at the extreme tip of the subule to an extension of the forking to the whole of the subule. In some cases the forking extended to the base of the column. Narrow as the awn is, the forking did not halve the thinness, but each awn of the fork retained the usual narrow width, so much so that in the unforked portions they were noticeably wide.

As in the case of midrib forking, the manifestation of this forking of the leaf-blade need not appear in every plant, nor in every leaf. If it does not manifest in the adult stage, evidences of its presence are betrayed by the leaves of the seedlings. In one pure line six selections that showed forked leaves in the adult plants and three that did not show forked leaves, were selected and germinated. Instead of the usual 95 per cent. of normal germination, all these gave only 75 per cent. In every one of the selections about 8 per cent. of the seedlings showed forking in one or other of the first four seedling leaves. Since all of them gave some plants with forked leaves, this character must have been nascent in the 3 adults that did not show it. In the seedlings the forking, when it showed, was most frequent in the first leaf and next in the second leaf. The peculiarity of the forking in the first two leaves that lacked a well-defined midrib was, that the forking split the blade into two. When this forking was intense it easily invaded the leaf-sheath past the nebulous ligular zone. In 20 instances splitting of the coleoptile was noted. None of these 20 seedlings survived.

This concurrent manifestation of a very rare, probably atavistic, abnormality in two such homologous organs as the leaf-blade and the awn is interesting.

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B. W. X. PONNAIYA.
T. VENKATARAMANA REDDY.
Agricultural Research Institute,
Coimbatore,
October 29, 1935.

[1] *Madras Agric. Jour.*, 1930, **18**, 526-530.

Fate of the Embryonic Membranes in Insects.

THE formation of two embryonic membranes, the amnion and the serosa, is characteristic of insects, although in exceptional cases one or both of these membranes may be absent. Regarding their fate, four main types have been so far recognised, *viz.*, involution through the formation of a dorsal amnio-serosal sac; involution of the amnion with the retention of the serosa; involution of the serosa with the retention of the amnion; and finally, retention of both the amnion and serosa (*vide* Imms).[1] In all these cases, except the last one, the membranes degenerate some time before hatching. The dorsal organ may be formed from the amnion or the serosa or both.

In the Tettigonids *Xiphidium* and *Orchelimum* (Wheeler)[2] and in the Mantid *Paratenodera sinensis* (Hagen)[3] a third embryonic membrane, the indusium, occurs besides the amnion and the serosa. In the Tettigonids a single dorsal organ is formed from the indusium, while the other two membranes are dissolved into the yolk. In *Paratenodera*, on the other hand, *two* dorsal organs are formed, one from the serosa and the other from the indusium, while the amnion degenerates; this formation of two dorsal organs is unique among insects.

In some of the parasitic Hymenoptera, a single, peculiar membrane, the throphamnion, is formed. It is not comparable with the other embryonic membranes and appears to be a structure *sui generis*, being formed, in some cases, from the polar bodies (Silvestri).[4] In most cases it degenerates, but in some the cells dissociate from one another, round themselves and increase in size and live for a long time in the body fluid of the host where they serve as food for the parasitic larva. A similar fate occurs in regard to the serosa of several parasitic Hymenoptera and evidence thereto has been marshalled recently by Jackson.[5,6]

It will be seen from the above summary that no case has so far been reported in which a portion of the serosa completely degenerates whereas the other portion persists until hatching. During my investigations on the embryology of the European Migratory Locust, *Locusta migratoria* L., I have discovered such a condition. During blastokinesis or turning round of the embryo, the amnion and the serosa rupture. The whole of the former forms a provisional dorsal closure of the embryo and then quickly degenerates. The serosa, on the other hand, is divided into two portions. By far the largest portion of it goes to form the dorsal organ, while a very small, saucer-like area (Fig. 1, *Q*) remains at the posterior or micropylar pole of the egg and persists until hatching. This area may be called the *posterior serosal patch* and has so far not been described in any other insect. Further, it is interesting to note that this posterior serosal patch does not remain unchanged, but undergoes definite changes of organisation. At first the cells of this area are irregularly arranged. After about two days (at 33° C.) of its separation from the main serosal mass, it shows (Fig. 2) a bi-layered arrangement of its cells, with a rather indistinct space (Fig. 2, *O*.) in between.

This arrangement persists until hatching when the posterior serosal patch is cast off with the egg-shell.

Finally, I should not fail to point out that the occurrence of this phenomenon, *viz.*, the persistence of the posterior serosal patch until hatching and the degeneration of the rest of the serosa long before hatching, provides us in the locust a very suitable material for the investigation of an interesting and important problem of Entwicklungsmechanik. Is the degeneration of the anterior portion of the serosa induced by its association with the yolk at the cephalic end of the embryo? Two methods of attack are possible for the solution of this question. The small posterior serosal patch could be transplanted near the cephalic end of the embryo in the neighbourhood of the dorsal organ, and observations made as to whether it degenerates there or persists as in its original place. I have performed several such experiments without success. The difficulty lies in the fact that the locust egg invariably dies a few hours after it is experimented upon. In view of this difficulty for the solution of which I, at present, cannot see any way, the second method of attack, which I have not so far tried, appears to be much more hopeful. It would be interesting to know whether these two portions of the serosa which behave so differently in the living egg would do the same in *in vitro* cultures. Artificial culturing of insect tissues is extremely difficult because it is by no means easy to obtain sufficient quantities of a suitable culture medium. For this purpose I would refer to the papers of Goldschmidt[7] and Frew[8]. Once a suitable culture medium is obtained, I have no doubt that the serosa would provide an exceptionally good material for *in vitro* cultures.

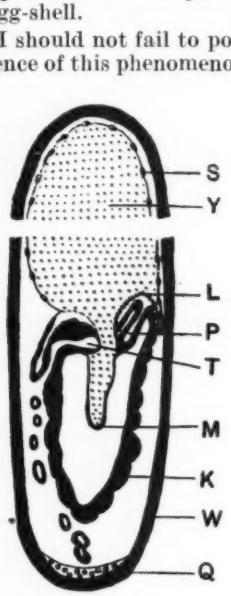


Fig. 1.

Longitudinal vertical section of an egg of *Locusta migratoria* during blastokineses. Diagrammatic. × 22.

K, embryo; *L*, amnion; *M*, splanchnic mesoderm and provisional dorsal closure; *P*, proctodæum; *Q*, posterior serosal patch; *S*, serosa; *T*, stomodæum; *W*, egg-wall; *Y*, yolk.

Fig. 2.

The posterior serosal patch from a longitudinal section of an egg of *Locusta migratoria* about two days after blastokinesis. Note the bi-layered arrangement of the nuclei with a cavity in between. × 240.

N, nucleus; *O*, cavity.

M. L. ROONWAL.

Department of Zoology,
Government College, Ajmer.
September 14, 1935.

[1] Imms, A. D., *A General Text-Book of Entomology* 1934, 3rd Ed., London.
[2] Wheeler, W. M., *J. Morph.*, 1893, **8**.
[3] Hagen, H. R., *J. Morph.*, 1917, **30**.
[4] Silvestri, F., *Boll. Lab. Zool. Portici.*, 1906, **1**; 1921, **11**.
[5] Jackson, D. J., *Proc. Zool. Soc.*, London, 1928.
[6] Jackson, D. J., *Nature*, 1935, **135**.
[7] Goldschmidt, R., *Biol. Centralb.*, 1916, **Bd. 36**.
[8] Frew, J. G. H., *Br. Jr. Exp. Biol.*, 1928, **6**; 1929, **6**.

The Respiratory Mechanism of the Frog.

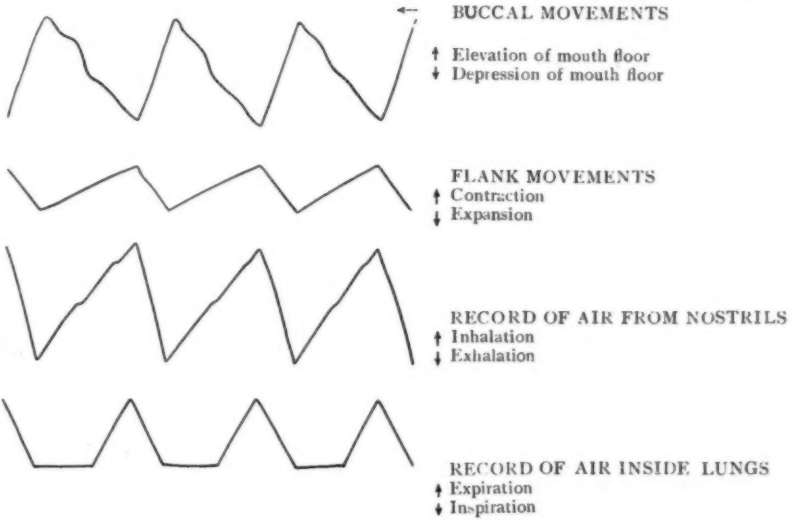
EXCEPT Wedenski and Willem (1918), all others, Gaupp (1900), Baglioni (1901), Bruner (1914), Goppert (1903) and Heinemann (1884), appear to have made no experimental observation; and of the former two, Willem alone has used the graphical method. According to Gaupp, the two processes—expiration and inspiration of air into the lungs—are preceded by a third process—aspiration of air into the mouth. This account does not explain the exit of air

from the mouth. Others, principally Willem, therefore describe two phases (buccal ventilation and pulmonary ventilation) taking place alternately. Almost all accounts state or imply that the lungs and the mouth are ventilated one after the other. Experiments show that they are ventilated simultaneously and that the breathing mechanism is much simpler than has been described hitherto.

The movements of the flanks were recorded on smoked paper and it was found (*a*) that they were uninterrupted, continuous and regular; (*b*) that they are of uniform magnitude. The buccal movements when similarly recorded on smoked paper showed that they were also continuous and uniform. A simultaneous record of both the buccal floor and the flanks showed that when the mouth-floor is raised, the flanks distend and when the flanks contract the mouth-floor is lowered. It is inferred from this that when the buccal floor is elevated, the mouth cavity is reduced and the air is pumped into the lungs and that when the body wall contracts, the air is pressed out of the lungs into the mouth.

The opening and closing of both the nostrils as well as the glottis was observed by graphical records of the air currents. The air going in and out of the nares was led into a tambour by a mask applied to the snout and was recorded—the graph showed uninterrupted inhalations and exhalations. By taking this record of air along with the movements of the buccal floor, it was found that when the mouth floor was raised, the air was exhaled and was inhaled when the mouth floor was lowered. The hyoid apparatus and associated muscles are capable of raising the buccal floor.[1] The air currents were also recorded with the movements of the flanks and the graphs showed that when the air goes out of the nostrils (exhalation), the flanks dilate (inspiration) and when the flanks collapse (expiration), the air enters the nostrils (inhalation). The closing and opening of the glottis was observed by anæsthetising a frog and introducing a slender tube into each lung and leading the air in the lungs into a tambour and thus recording the entrance and exit of air from the lungs. This graph also showed regular and uniform expirations and inspirations.

Scheme of records to illustrate the synchronism of various movements concerned in the respiration of frog.



Putting together the tracings of the buccal movements, flank movements, air currents from nostrils and from lungs the interpretation of the respiratory mechanism would be as follows: When the buccal floor is lowered, outside air is inhaled through the nostrils into the mouth cavity while the air inside the lungs is sucked (and also squeezed by the body wall) through the glottis into the buccal cavity. Thus the fresh and the impure air mix in the mouth chamber. When the buccal floor is elevated, this mixed air rushes out of the nostrils as

well as into the lungs. The graphs of the air currents make it clear that neither the nares nor the glottis are completely closed for any long interval. They constrict in such a way that the buccal floor oscillations increase or decrease the pressure in the mouth chamber.

The rôle played by the body wall and the elasticity of the lungs in this mechanism can be demonstrated by preventing the mouth of a frog from closing and thus throwing the buccal floor out of action. Graphical records of the flanks show a series of expirations followed by no inspiration—until the expirations become extremely feeble. Thereafter each weak expiration is followed by a feeble passive inspiration and the frog continues to breathe in this way. This co-operation of the buccal floor and the body wall serves to lead up to the reptiles the more primitive members of which employ the buccal floor as well as the ribs to ventilate the lungs.[2]

C. P. GNANAMUTHU.

Madura,
October 28, 1935.

[1] *Rec. Ind. Museum*, June 1933, Anatomy of the tongue of *Rana hexadactyla*.

[2] *Curr. Sci.*, Oct. 1933.

The Sub-central Foramina of the Squamata.

SINCE writing a note[1] on the presence of paired apertures on the ventral aspect of the vertebral centra in the common house-gecko, *Hemidactylus flaviviridis* Rüppel, I have been on the look-out for previous references to them in zoological literature. A consultation of such standard text-books of zoology as Sedgwick[2], Wiedersheim and Parker[3], Hertwig and Kingsley[4], Kingsley[5], Reynolds[6], Parker and Haswell[7], Hyman[8], Goodrich[9] and de Beer[10], shows that these apertures have somehow escaped the general observation of many eminent zoologists. As pointed out by Ramanujam and Ramaswami[11], however, Owen[12] recorded them for the Ophidia long before Mookerjee and Das[13]. More recently, Camp[14] has studied and sketched the vertebræ of 22 species of lizards for this feature. He says:

"The size of the intervertebral canals, large in the Geckonidæ and Xantusiidæ, undergoes reduction in the more advanced groups. The paired sub-central foramina, present in geckos, pygopodids and amphisbænians.... appears less frequently among the Scincomorpha and are absent in the higher anguimorphs and in the chamæleons."[15]

This statement seems to imply that the presence and size of these apertures is a primitive feature in lizards, and that it, therefore, adds to the "Paleotelic Weight"[16] of the animals in which it is found. If this notion is right, it is a significant fact that these apertures in *Hemidactylus* are larger in size relatively to the size of the whole centrum than in the vertebræ of the four species of Geckonidæ, figured by Camp, *viz.*, in *Thecadactylus rapicauda*, *Tarentola cubana*, *Sphærodactylus macrolepis* and *Coleonyx variegatus*.

Goodrich[17], although he makes no mention of the presence of sub-central foramina in this work, gives an instructive diagram about the "relations of *sclerotomes* and development of *vertebral column* in *Amniota*", which seems to suggest that these apertures are really intersegmental in position and represent the sclerotomic segmentation of the earlier stages in the case of the adult. The position of the intersegmental artery in his diagram (Fig. 1) coincides very well with the

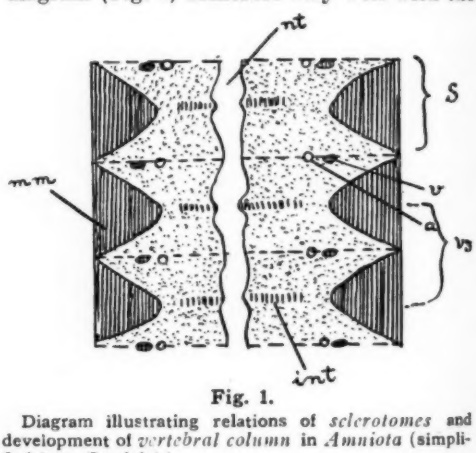


Fig. 1.

Diagram illustrating relations of *sclerotomes* and development of *vertebral column* in *Amniota* (simplified from Goodrich).

a, intersegmental artery; *int*, intervertebral ligament; *mm*, myomere; *nt*, notochord; *S*, region between two transverse broken lines occupied by one body segment; *v*, intersegmental vein; *vs*, region occupied by one vertebral segment composed of a half-sclerotome from each of two consecutive segments.

position of the sub-central foramina in *Hemidactylus* (Fig. 2) and other Squamata. Thus these apertures are probably reminiscent of a former condition and may be regarded as primitive features.

Granting the intersegmental position and the primitive nature of these foramina, it

Fig. 2.

Photomicrograph of the ventral aspect of the centra in *Hemidactylus flaviviridis*.

itc, intercentrum; *r*, median ridge; *scf*, sub-central foramen.

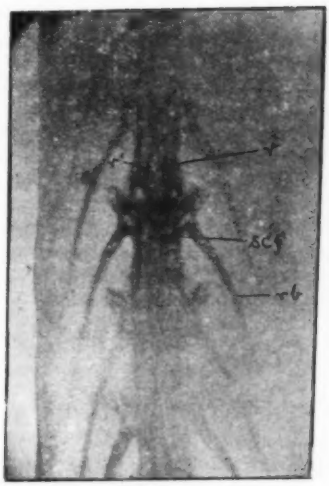


Fig. 3.

Photomicrograph of the Vertebral Column of *Typhlops braminus* from ventral aspect.

r, *r'*, ridges; *rb*, rib; *scf*, sub-central foramen.

would be interesting to find out whether any types of the Amphibia, extinct or living, show these apertures at any stage of their development. An examination of the vertebræ of the extinct genus *Aræoscelis* Williston, which is said to represent the ancient stem from which the Lacertilia arose,[18] might be worth while in this connection, as also a fresh scrutiny of the vertebræ of *Sphenodon*. In the latter case, I might mention that Günther[19] and others do not make any mention of these apertures. I hope that those zoologists who have access to this type of materials will throw some light on this question.

In the present stage of our knowledge, it is impossible to be certain whether the *single* sub-central foramen of *Typhlops*[20] is actually homologous to the *paired* apertures found in lizards and in some snakes. I am, however, inclined to believe that it is not. Recently, I prepared two alizarin-stained skeletons of this snake to confirm Mookerjee and Das's findings, and my attention was especially attracted by two differences in this connection. In the first place, the apertures in *Typhlops* (Fig. 3) are placed far more anteriorly than those in *Hemidactylus*, being just a little behind the anterior ends of the centra. Secondly, two slight ridges in the case of *Typhlops* start at the posterior end of the ventral aspect of each centrum and converge towards each other as they run forwards, the single sub-central aperture being situated where they should meet together. In *Hemidactylus*, on the contrary, there is a prominent single median ridge, situated longitudinally on the ventral aspect of each centrum, and the apertures in question lie one on each side of it.

An examination of the vertebræ of two other families of Snakes—*Boidæ* (*Eryx jaculus* Linné, *Python molurus* Linné) and *Colubridæ* (*Ptyas mucosus* Linné, *Naia tripudians* Merr.)—shows the presence of *paired* (not single) sub-central foramina, and thus the case of *Typhlops*, as far as has been investigated up to the present, is a solitary one amongst the Ophidia. However the sketch of the ventral aspect of a vertebra of the extinct snake *Palæophis typhæus* Owen, as given by Lydekker,[21] raises the suspicion that this snake had not two sub-central apertures like the *Boidæ* and the *Colubridæ*, but a single aperture which was situated nearer the posterior than the anterior end of the centrum. This feature, if confirmed in actual specimens of the vertebræ, might prove important insomuch as it would make *Palæophis* appear to be related to the *Typhlopidæ* rather than to the *Pythoninæ*, with which latter it is believed to have affinities.

Some time back, I requested Mr. E. R. Gee, Director, Geological Survey of India, to

scrutinise the vertebræ of *Palæophis* for this feature, but unfortunately the palæontological collection in his charge does not include any vertebræ of extinct species of Snakes and Lizards. I hope, however, that some one else who has access to such material, might examine them. I am grateful to Mr. Gee for kindly examining the fossil vertebræ of several *extant* species of Snakes for me and for reporting the presence of paired appertures on the ventral aspects of their centra. "The apertures," he says, "are in the form of narrow slits."

BENI CHARAN MAHENDRA.

St. John's College,
Agra,
October 3, 1935.

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[1] Mahendra, B. C., "On the Peculiar Apertures in the Vertebral Centra of *Hemidactylus flaviviridis* Rüppel," *Curr. Sci.*, 1935, **1**, 34.

[2] Sedgwick, A., *A Student's Text-book of Zoology*, 1905, II.

[3] Wiedersheim, R., *Comparative Anatomy of Vertebrates*, adapted by W. N. Parker, 1907.

[4] Hertwig, Richard, *A Manual of Zoology*, translated by J. S. Kingsley, New York, 1912.

[5] Kingsley, J. S., *Comparative Anatomy of Vertebrates*, London, 1912.

[6] Reynolds, S. H., *The Vertebrate Skeleton*, Cambridge, 1913.

[7] Parker, T. J., and Haswell, W. A., *A Text-book of Zoology*, 1921, II.

[8] Hyman, L. H., *A Laboratory Manual for Comparative Vertebrate Anatomy*, Chicago, 1929.

[9] Goodrich, E. S., *Studies on the Structure and Development of Vertebrates*, London, 1930.

[10] Beer, G. R. de, *Vertebrate Zoology*, London, 1932.

[11] Ramanujam, S. G. M., "Vertebral Centra of *Typhlops braminus*," *Curr. Sci.*, 1933, **2**, 178-79.

[12] Owen, R., *Comparative Anatomy o Vertebrates*, 1886, **1**, 53.

[13] Mookerjee, H. K., and Das, G. M., "On the Peculiar Apertures in the Vertebral Centra of *Typhlops braminus*," *Proc. Zool. Soc.*, 1933, 283.

[14] Camp, C. L., "Classification of the Lizards," *Bull. Amer. Mus. Nat. Hist.*, 1923, **48**, 289, 481.

[15] Camp, C. L., *op. cit.*, 344.

[16] Camp, C. L., *op. cit.*, 332.

[17] Goodrich, E. S., *op cit.*, Fig. 62, p. 56.

[18] Williston, S. W., "The Phylogeny and Classification of Reptiles," *Jour. Geol.*, 1917, **25**, 309-321.

[19] Günther, A., "Contribution to the Anatomy of *Hatteria* (*Rhynchocephalus*, Owen)," *Phil. Trans. Roy. Soc.*, 1867, B. **157**, 604 606.

[20] Mookerjee, H. K., and Das, G. M., *loc. cit.*

[21] Lydekker, Richard, "Catalogue of the Fossil Reptilia and Amphibia in the British Museum," 1888, **1**, Fig. 56, p. 258.

A Contribution to the Stratigraphy of Bagh Beds.

BAGH BEDS representing the marine facies of the Cretaceous of the Narbada valley, occur in several detached areas on the northern side of the Narbada from Barwai on the Khandwa-Indore railway line on the east to Wadhwan in Kathiawar on the west. The earliest references to the fossiliferous limestones of these formations are by Dangerfield in 1818, and by Colonel Keatinge in 1856[1] but the geology of the areas was first worked out by W. T. Blanford[2] and later studied in detail by P. N. Bose.[3] These beds occur as inliers in the Deccan Traps, the principal exposures being those near Chirakhan, Bagh and Kawanth. According to Blanford and Bose the stratigraphical sequence obtaining in these areas is as follows :—

		Position of the new beds
Deccan Trap.		Fossil Wood and Breccia Zone
Bagh Beds	(Upper) Coralline Limestone	
	Deola-Chirakhan Marl	Lower Coralline Limestone
	Nodular Limestone	
	Nimar Sandstone	
Gneisses ; Gondwanas, etc.		

During a short visit to these formations in the Chirakhan area, a few months back, the authors have traced a new bed in the above sequence in this region : A bed of bryozoan limestone, 3–5 ft. thick, occurring between Nodular Limestone and Deola-Chirakhan Marl and provisionally named here as Lower Coralline Limestone.

This horizon has been traced round Badiya, Chirakhan, Sitapur, Audiyapur and Deola, the best development, however, occurring on hillocks near Deola and Sitapur. It is separated from the (Upper) Coralline Limestone by the bed of soft Deola Marl which on differential denudation has left the Coralline Limestone bands, both at the top and at the base, as projecting rock masses. In certain places, the Lower Coralline Limestone band is very thin and inconspicuous and as such escapes notice. It is a hard granular rock, brownish yellow in colour and is full of bryozoa. The fossils provisionally identified from this horizon include *Eschara*, *Ceriopora*, *Thamnastræa*, *Hemiaster*, small

rhynchonellids, *Placenticeras*, *Inoceramus*, *Cardium*, *Venus*, etc.

The Upper Coralline Limestone of the Chirakhan-Deola area resembles the Lower Coralline band to a great extent in lithology and in external appearance, and but for the intervening band of Marl, cannot be easily distinguished. In certain western exposures of the Bagh Beds, Coralline Limestones are reported to be capping Nodular Limestone with the supposed intervening Marl missing, its absence being attributed to its soft nature and its consequent denudation. In the light of the present discovery it appears very probable that the Coralline Limestones of the western exposures are in their normal position and correspond to the Lower Coralline Limestone horizon of the Chirakhan area and not to the (Upper) Coralline Limestone as suggested by the previous authors.

The discovery of a lower horizon of Coralline Limestone therefore necessitates the amendment of the stratigraphical sequence of the Bagh Beds as shown in the above Table.

K. P. RODE.
G. W. CHIPLONKAR.

Department of Geology,
Benares Hindu University,
September 15, 1935.

[1] *Jour. As. Soc. Bengal*, 1858, **27**.
[2] *Mem. G.S.I.*, 1869, **6**, Pt. 3.
[3] *Mem. G.S.I.*, 1884, **21**, Pt. 1.

On a Fossil Wood and Breccia Zone in the Deccan Trap in Deola-Chirakhan Area, Central India.

DURING a recent visit to the Chirakhan area, we have noticed more or less continuous zone of fossil wood and breccia at the contact of Traps and the Bagh Beds. It is a very definite horizon being met with in almost all the localities wherever the Bagh Beds are overlain by the Traps. It has a sharp junction with the underlying coralline limestones but has no such demarkation on its upper limit where it merges into the normal traps.

In most places this zone is characterised by the exclusive abundance of fossil wood strewn over the surface, in a loose condition, under a thin covering of trappean soil. Fossil wood specimens, which to all appearances are dicotyledonous in nature, range in size from small fragments to huge tree trunks about 4 ft. in diameter and more than 40 ft. in length. The wood has been completely jasperised and is left with practically no trace of internal structure; the gross surface features and sometimes the rings of growth are very clearly seen.

In certain localities as near Badiya, Phutabaodi and Chirakhan, in addition to fossil wood, we also observe in the same zone an extensive occurrence of breccia in the form of a scattered band irregularly spread over the surface. Anything approaching a regular band occurs only at Badiya. The rock is a hard indurated type of breccia composed of variously sized angular or subangular fragments of limestones, sandstones, jasper and pieces of fossil wood, all heterogeneously cemented in a calcareous and ashy material. The fragments vary in size from tiny grains to blocks more than a foot in diameter. This unassorted and fragmental nature of the material may be due to absence of any sorting action of water or may indicate formation of the rock *in situ*. The presence of the ash in the matrix demonstrates its close association with the volcanic activity as also does the presence of jasper which is usually found in steam cavities in lavas.[1] The complete loss of internal structure in the fossil wood may be due to the heat of contact with the lava or due to rapid replacement of wood tissues by heated solutions. These considerations together with the strictly sub-trappean position of the band in the field strongly suggest that the formation of the breccia and the fossilisation of the wood are very intimately connected with the activity of the lava flows. It is not thus unlikely that the forest growth together with the rock debris was overwhelmed by volcanic ash and was subsequently buried under a lava flow, the heated fluids bringing about the cementation of the debris into a hard breccia and also the fossilisation of the plant remains with almost complete obliteration of the structure, the cold surface waters having little part in the formation of either. The fossil wood and breccia thus characterise the lowest flows of the Deccan Trap in this region.

K. P. RODE.

Department of Geology,
Benares Hindu University,
September 26, 1935.

[1] Goodchild, 'Precious Stones,' 1908, pp. 165, 175.

The Age of the Inter-Trappean Beds near Rajahmundry.

IN the course of a recent examination of the several inter-trappean exposures near Kateru, Pungadi and Dudukur, we have made two important observations which throw some light on the age of the Deccan traps—a subject on which there has recently been some comment by Dr. Sahni[1] and Dr. Fox.[2]

Thin sections of the limestones forming the lowest beds of the Deccan inter-trappean series near Pungadi and Dudukur have revealed, among other fossils, remains of algæ belonging to the family Dasycladaceæ. Some of these slides were sent to Dr. Julius Pia (of the Natural History Museum, Vienna) for identification, and he has recognised *Acicularia* as the most common of these algæ. It is well known that, though members of the family Dasycladaceæ were fairly common throughout the Mesozoic, *Acicularia* is essentially a Tertiary form. This find of a Tertiary fossil alga from these beds is of great significance, especially in view of Dr. Sahni's discovery of fossil plants of Tertiary affinities among the fresh water inter-trappeans of Nagpur-Chhindwara region.

Among the inter-trappean beds near Kateru, we have noticed the occurrence of numerous Charophytic remains in an excellent state of preservation. Among these the following species of *Chara* have been tentatively identified: *C. Wrightii*, *C. helicteres*, *C. ovlata*, *C. vasiformis*. *C. turbinata*, and *C. strobilocarpa*: and all of these are seen to be of distinctive Tertiary affinities.

In view of the fact that the traps near Rajahmundry must be considered as belonging to the lowest division of the Deccan traps as a whole, the two palæobotanical evidences we have cited above appear to be definitely in support of Dr. Sahni's suggestion that the Deccan trap flows are of an early Tertiary age.

S. R. NARAYANA RAO.
K. SRIPADA RAO.

Department of Geology,
Mysore University,
November 3, 1935.

[1] *Curr. Sci.*, 1935, **3**, 134.
[2] *Curr. Sci.*, 1935, **3**, 428.

Phosphatases of the Brain.

Two phosphatases, distinguished as acid and alkaline phosphatases and characterised by differences in optimal p_H are known to occur together in certain organs of the body. Thus, liver, kidney (Bamann and Riedel[1]) and spleen (Davies[2]) contain the two phosphatases. On the other hand, bone, intestines, blood plasma and erythrocytes contain only one type of the enzyme.

The phosphatases of the brain have not been investigated from this point of view. The present note relates to the presence and behaviour of two phosphatases in the brain (of the sheep). The alkaline phosphatase has an optimal reaction of p_H 9·6, and is activated by magnesium ions, the increases in activity exceeding 100 per cent. when magnesium is added in optimal quantities (0·001 M—0·002 M); the acid phosphatase which has an optimal reaction of p_H 5·0 is not activated by magnesium and resembles the urine[3] and salivary[4] phosphatases. The two phosphatases of the brain are thus similar to those of the other organs, in their behaviour towards magnesium.

Waldschmidt-Leitz and Nonnenbruch[5] consider that the alkaline phosphatase is typical for all organs; they suggest that the acid phosphatase demonstrated by Bamann and Riedel[1] is really due to the presence of erythrocytes in their extracts. This, however, appears to be untenable because the erythrocyte phosphatase is activated by magnesium salts, while the acid phosphatase extracted from the brain and the organs is not so activated.

Further work on the phosphatases of the brain is in progress.

K. VENKATA GIRI.
N. C. DATTA.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
November 6, 1935.

[1] Bamann and Riedel, *Zeitschr. f. Physiol. Chem.*, 1934, **229**, 125.
[2] Davies, *Biochem. J.*, 1934. **28**, 529.
[3] Kutscher, *Zeitschr. f. Physiol. Chem.*, 1935, **235**, 62.
[4] Giri, K. V., unpublished work.
[5] Waldschmidt-Leitz and Nonnenbruch, *Naturwissen.*, 1935, **23**, 164.

A Note on the Jassid Bugs of Paddy.*

Introduction.

PADDY (*Oryza sativa*) is subject to the attack of about three dozen insect pests of which eight or nine, such as the paddy stem borer (*Schœnobius incertellus*, W.), the paddy swarming caterpillar (*Spodoptera mauritia*, B.), the rice bug (*Leptocorisa acuta*, Th.), the rice grasshopper (*Hieroglyphus banian*, F.), the rice case-worm (*Nymphula depunctalis*, Gr.), the paddy gall-fly (*Pachydiplosis oryzæ*, W.), the rice Hispa and Leptispa, are major pests. The Jassid bugs of paddy, however, come under the group of minor pests. Normally they do not do much harm to the plant but, in certain years, cause fairly serious damage.

Jassids—What these are.

Jassids are plant bugs belonging to the sub-order *Homoptera*, order Rhynchota. These have sucking type of mouth parts and two pairs of wings. They have an incomplete metamorphosis. Eggs are laid on the tender portions of the plant and the young ones which hatch out—nymphs—and also the adult bugs suck the juice of the plants and, if found in large numbers, the affected portions fade and dry up as a result of the attack.

Species of Jassids affecting Paddy.

Four species have been known to affect paddy in the Madras Presidency. These are the green-spotted Jassid (*Nephotettix bipunctatus*, F.); the white Jassid (*Tettigoniel spectra*, D.); *Erythroneura subrufa*, M., and *Deltocephalus dorsalis*, M. Of these, the first two are found in almost all paddy areas while the third one is commonly noticed in North Malabar and the last in the Northern Circars.

Control Methods.

Collection of nymphs and adults with hand-nets or bags have been found to be successful against the pest. The use of sticky winnows is yet another method advocated in some places. Light traps have also been tried especially against the green-spotted Jassid. The use of tobacco dust mixed with lime has given successful results against nymphs.

M. C. CHERIAN.

Agricultural Research Institute,
Lawley Road P.O., Coimbatore,
October 29, 1935.

* In view of the recent outbreak of *Jassid* pest of paddy in Godavari delta, this account given by Mr. C. Cherian will be of interest (Ed.).

A Note on the Locust Position in North-West India and Baluchistan during the Current Year—1935.

EXPERIENCE gained during the last three years has shown that the multiplication of the Desert locust is entirely dependent on favourable rainfall in its breeding areas. During the winter and spring of 1934–35, early, wide-spread and heavy rains were received throughout the winter-rainfall areas of Baluchistan and Persia, and many of the coastal areas, such as Jask, Gwadar, Pasni and Ormara, recorded more than 10 inches of rain between December 1934 and April 1935. In the wake of such favourable rainfall, the locust was noticed to begin egg-laying early in February, and by April 1935 adult locusts of the new generation were found to have come into existence in fairly large numbers.

In the hinterland of Mekran, two cases of damage to *Jowari* crops by bands of gregarious hoppers were reported in June and July respectively, and on investigation, it appeared as if the hoppers had come into existence as a result of concentrated egg-laying in the sandy areas close by, by individuals of the first generation, that had been produced in the coastal areas and had, later on, migrated into the interior of Mekran. The adult locusts emerging from the infestations mentioned above are reported to have disappeared after acquiring wings. Since the interior of Mekran becomes an area of high temperatures and low humidity during July, August and September, it is presumed that they flee from such uncongenial conditions in search of better environmental conditions elsewhere.

By about the second week of July, a sudden increment in the numbers of locusts was noticed in several different places almost simultaneously: for example, at

Pasni, Gwadar, Ormara and Sonmiani along the Mekran Coast, in a large number of places in Sind, especially in Dadu, Sukkur, Hyderabad, Karachi and Tharparkar Districts, in Nushki and Kachhi in Upper Baluchistan, in the Khairpur and Bahawalpore States, and in many parts of Marwar, Jaisalmer and Bikaner States. In most cases, the incursion appears to have occurred as an imperceptible immigration of individuals, though in a few places swarms of small size were also reported. It is also noteworthy that a great proportion of the locusts collected after this incursion was found, on biometrical analysis, to show elytron-femur ratios pertaining to the *transiens* and *gregar* types, whereas the individuals found before this event in Sind and Rajputana deserts were mostly of the *solitaria* facies.

There was general rainfall in Western Rajputana and in the Thar portion of Sind during July, and oviposition by locusts was noticed to some extent in these areas in July and August, but during August and September rainfall was greatly restricted. On the other hand, in most parts of Sind and Baluchistan subject to the influence of the monsoon, there was a complete failure of rains, and consequently there was no breeding.

The new generation of locusts made their appearance in September in the desert areas of Sind and Rajputana, but though widely scattered over a large area of desert, locusts were found on the whole to be in comparatively small numbers. Their biometrical ratios, moreover, were noticed to be mostly of the *solitaria* type. Observations made so far appear to indicate that this year's incursion—presumably from a western source—has fizzled out and that at present there is no ground for anticipating the formation of swarms.

During the year 1926, a similar incursion, though presumably of a greater magnitude, occurred at about the same time of the year, and as a result of very heavy summer rainfall throughout Baluchistan, Sind and Rajputana, the resultant breeding was so extensive as to start the last great Locust Cycle of 1926–31. One wonders what might have happened if the current season's monsoon had been heavier and more prolonged.

Y. RAMACHANDRA RAO.

Locust Research Station,
Karachi,
November 1, 1935.

Obituary.

Major Robert Ferguson Stirling (1886—1935).

IT is with deep regret that we have to announce the death, from heart failure on 16th August last at Nagpur, of Major Robert Ferguson Stirling, Director of Veterinary Services, Central Provinces. By his death at the early age of 48, India has lost one of the pioneer Veterinary workers in this country.

Born in 1886, he qualified with distinction as Member of the Royal College of Veterinary Surgeons from the Dublin Veterinary College. Soon after, he accepted an appointment in the Rhodesian Veterinary Service where he lay the foundations for his future interest in tropical diseases of animals. In fact, his thesis for his Fellowship of the R.C.V.S., which he took in 1912, was on the control of East-Coast Fever of cattle.

On the outbreak of the Great War, he joined the Royal Army Veterinary Corps and found active service in France. His army service called for high praise from his superior officers and particularly from Major-General Sir John Moore, K.C.M.G., etc., the then officer commanding the Veterinary personnel of the British Expeditionary Force in France. An appreciation of the late Major Stirling's work published in the *Veterinary Record*, London, by Sir John, is read with pleasure by many of the friends and colleagues of the deceased officer.

He joined the Civil Veterinary Department in C.P. in April 1920 and except for a short break when he was called on to officiate as Pathologist at the Imperial Institute of Veterinary Research, Muktesar, he continued to be in C.P. first as Deputy Director and subsequently as Director of Veterinary Services, C.P. In the latter capacity for well over seven years, he brought into his work scientific and organising capacity of a high order which had been the pride and envy of his colleagues and friends.

His scientific talents which found early vent in the study of East-Coast Fever in cattle, later developed with the limited opportunities for an administrative officer

in this country to the detection of Ranikhet disease in Fowls and the treatment of *Piroplasma gibsoni* in dogs and *P. bovis* in cattle.

His greatest achievement in Scienec, however, is his work on Rinderpest in cattle and its control. The first two progress reports on this work which appeared in scientific journals were well received by Veterinary workers all over the world and the third and final report which was almost ready for publication, at about the time of his death, will, it is hoped, be published in due course.

Personally Major Stirling was a most amiable man and made many friends amongst Indians. He was further able to induce a great deal of his enthusiasm for work amongst his co-workers and subordinates and to further this object, founded the C.P. Veterinary Association with its own *Quarterly Journal*. The latter had been the means of stimulating the subordinate Veterinary workers into expressing in accurate language the results of their observations of obscure diseases in the field. His energy for work was unbounded and he hardly restricted himself to the prescribed hours for office work. His end was very unexpected. To Mrs. Stirling who was on a holiday in England when the sad event took place and who was all through the late Major's career more than a helpmate to him and to mother Mrs. Stirling, we offer our sincerest condolences.

R. V. P.

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Provash Chandra Basu.

THE sudden death of Mr. Provash Chandra Basu, M.B., M.Sc., P.R.S., at the early age of 31 years on Friday, the 6th of September, has cut off a brilliant career at its very outset. Mr. Basu was a very distinguished student, and carried on his studies simultaneously in the Medical College whence he obtained the M.B. degree, and in Anthropology in the Calcutta University for which he was awarded the M.Sc. degree and later the greatly coveted Premchand Roychand Research Studentship. Both in the University and in the Medical College his career was exceptionally brilliant and he was awarded a number of scholarships, medals and prizes. Later, he was also selected by the Government of Bengal for a research scholarship for anthropological and ethnological studies; during the period of this studentship he carried out his work in the Anthropological section of the Indian Museum under the supervision of Dr. B. S. Guha. He was then appointed a research scholar of the Bose Institute, Calcutta and was attached to this institution till his sudden death.

Mr. Basu, as a result of his medical education, was specially suited for detailed anthropological studies and published several papers of importance in the *Journal of the Asiatic Society of Bengal* and in the *Transactions of the Bose Research Institute*, Calcutta. He also collaborated with Dr. B. S. Guha of the Zoological Survey of India in a publication in the *Anthropological Bulletins* issued by the Department, on the human relics recovered from the Naga Hills by the Expedition which was sent in 1926–27 for the abolition of human sacrifice. Special attention may be directed to his work on the Bhuiyas of Maurbhanj, the Racial affinities of the Mundas, and the so-called Pre-Dravidian tribes of India, while his studies on the Anthropological Measurements of the Mundas and Oraons also deserve special mention. In addition, he carried out detailed studies on Burmese crania and collaborated with Dr. Guha in his studies on the prehistoric human remains excavated at Mohenjodaro.

Mr. Basu's early death has unfortunately resulted in leaving his anthropological studies incomplete, but it is hoped that the work which he had so well started at the Bose Institute will be continued.

* * *

Edgar Thurston.

WE regret to record the death early in October when about eighty years old, of Mr. Edgar Thurston, well known as Superintendent of the Madras Government Museum for about twenty-five years, and as the author of *Castes and Tribes of Southern India*, the seven volumes of which, appearing in 1909, laid the foundations of ethnological research in South India.

Thurston was born in 1855 and educated at Eton and in the medical school of King's College, London. He was for some time in charge of the museum of that college, and came to India to take charge of the Madras Museum in October 1885 as its first full-time Superintendent. He seems to have found this Museum in a somewhat chaotic condition, without any very definite policy or aims, a state of affairs which he at once set himself to rectify. For we read in his first Annual Report, "It is wholly beyond the power or scope of a presidential museum to rival the great national museums in the possession of representative collections from different quarters of the globe, and I have

determined to devote my entire attention to the natural history, arts, ethnology, manufactures and raw products of Southern India, accepting only such specimens from other regions as may be sent as donations from time to time, and keeping them entirely apart from the main collections. The necessity for such a course is best illustrated by reference to the geological collections which, while abounding in a chaos of purchased and exchanged specimens of European fossils, is markedly deficient in specimens from the rich fossiliferous beds of the cretaceous system of Southern India." The policy which he thus established proved to be a sound one and, having been steadily pursued ever since, has resulted in the formation of the valuable South Indian collections for which the Museum is now known.

His wide interests and knowledge are indicated by the variety of subjects on which he wrote. These include coins, South Indian batrachians, fisheries and meteorites, as well as a number of papers on Anthropology; and under his guidance all sections of the Museum underwent great development, and the Connemara Public Library was founded with the Museum Library as its nucleus.

From September 1891 to November 1893, he officiated as Reporter on Economic Products to the Government of India in Calcutta. After his return to Madras he was appointed Lecturer in Comparative Anatomy at the Medical College for the year 1895-96, in addition to his permanent appointment. In 1901 he was similarly appointed Superintendent of the Ethnographic Survey of the Madras Presidency, which post he held till its termination in 1909. He finally retired in July 1910, but was absent on leave for some time prior to this.

* * *

Henry Fairfield Osborn.

WE regret to announce the death, at the age of 78, of Henry Fairfied Osborn, the eminent Palæontologist, well known for numerous publications, among which may be mentioned, "The Age of Mammals" (1911), "Huxley and Education" (1920), "Men of the Old Stone Age" (1915), "Origin and Evolution of Life" (1917).

Industrial Outlook.

Some Lines of Development of the Indian Paint Industry.

By N. Srinivasan, M.A.,

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THERE can be no doubt that the production of paint materials is a promising branch of Indian Industry. Its rise has been rather late; barely three decades have passed since it was initiated in the country. The first need of the industry in which practice has out-stripped theory, was a human one: experienced technicians. The second was special plant and machinery which constitute an important element in its establishment. These could not be met.

The advantages possessed by the Indian Industry, however, are many and obvious. It is well supplied with raw materials. It can depend on a large domestic market. Indian manufacturers could experiment under actual conditions to which they can adapt their processes. The creation of confidence in Indian manufactures, noticeable in recent times, is no small comfort to the industry. The Paint trade thus offers a great field of interesting possibilities for future accomplishment. It is true that, like many others, it has been through the trough of depression. But we are told there are indications of a return to a better trade. The new trend of industrial policy of the government is another healthy sign. The importance of technical research as a necessary aid to industrial progress has been realised since the days of the Holland Commission. The co-ordination of efforts in this direction under a unified control has also been very recently secured. With the establishment of a Central Industrial Research and Intelligence Bureau, might be said to begin a new chapter in Indian industrial development.

It may therefore be pertinent to take stock of what progress has been achieved in this particular branch; and indicate or reiterate those future lines of development which might yield to immediate enterprise and research. A detailed review of the

subject is not made. What is attempted is a selection for consideration of a variety of points. These have a general or particular interest when viewed from the following aspects:—(1) The Indian market for Paint products; (2) The natural resources available for exploitation; (3) The present state of technical efficiency in the country.

First take the raw materials. Among Paint vehicles the most important are Linseed and Tung oils. The position with regard to Linseed is strong. As for the other, great expansion is necessary to free the industry from Chinese supplies which are of bad quality and often adulterated. China wood oil possesses some unique properties and is an essential material in present day varnish making. Its ability to dry quick and its compatibility with synthetic resins are being exploited to best advantage. Another important property is its suitability for use with Rosin with which it gives the so-called Spar varnishes. This is of particular interest to the Indian Industry as Rosin is almost the only oleo-varnish gum available in the country. Rosin has hitherto not found favour as a good varnish-making material.

Experimental growing of Tung trees have been undertaken. It was found that the trees do well on Tea estates especially in Assam and Burma. The methods of cultivation of the plant in China are obscure. Systematic research in this aspect remains to be carried out; the soil conditions and methods of culture as affecting the yield of crop and processes of extraction and refining as influencing the quality of the oil. These studies would be of immediate value to the industry in its present endeavour to produce on an economic basis, oil of satisfactory quality. Trials of cultivation could be extended to other areas in the country.

Pigments play by far the most important rôle in Paint production. These could be classified under two heads, natural and chemical. The manufacture of pigments has mostly been undertaken by big Paint concerns for their use. The small consumer has hitherto been dependent on imports and these run high. The development of this line has attractive possibilities as pigments are used in other industries as well.

Among natural pigments, Barytes has a definite place in the stock of raw materials for the trade. The deposits in the Ceded Districts of the Madras Presidency and in Alwar are only too well known. Mainly through lack of initiative the available resources have remained unexploited. No export market can be found for the crude material. The extension of mining operations and the production of the material in various grades in a finely powdered form are most needed. That would destroy dependence on imports which still amount to more than half the consumption.

Lithopone is a chemically prepared white pigment which has assumed interest in recent times. Its advantages are many: excellent colour, great opacity, unique covering power, complete inertness and above all comparative cheapness. To-day its consumption rivals that of white lead. The production of this pigment which has yet to be undertaken in the country is important for the following reasons: It would stimulate mining to a larger extent, of the available deposits of barytes which constitutes the starting material for the manufacture of the pigment. The production of a variety of cheap paints with a Barytes-Lithopone base, particularly for the Indian market, remains to be carefully investigated. The recent tendency is to substitute the zinc oxide in enamels more and more by Lithopone and there is no prospect of the production of the oxide in the country. The complete absence of deposits of whiting—the base for the different types of water paints—would necessitate the substitution of Lithopone. Its unique opacity and covering power render possible its use in conjunction with large proportions of colloidal clay. Good white qualities of this material are forthcoming from different parts of the country. Lastly, mention might be made of the capacity of Lithopone to go with shellac varnishes to yield varnish paints which have special applications.

Lithopone is the mixed precipitate obtained by double decomposition of Barium Sulphide with Zinc Sulphate. Barium Sulphide could be produced by reduction of Barytes. As for the Zinc salt, one has to look elsewhere. It has been suggested that the blende from the Bawdwin mines of Burma can serve as raw material. In any scheme for the manufacture of the pigment there are two directions in which attention ought to be focussed: (1) The conditions of treatment of the precipitate so as to develop proper pigmentary properties. (2) The elimination of impurities for obtaining a light resistant material. Only then is standard Lithopone of commercial value possible.

Two other important whites are white lead and zinc oxide, the invariable constituents of exterior oil paints and enamels respectively. The raw material for their manufacture is again the mixed sulphide from Burma. White lead of satisfactory quality is being produced in the country from Burma lead by the precipitation process. There is no reason why production should not be increased. The outlook with regard to zinc oxide production by the direct process is discouraging. But the American method of preparation of cheap compositions containing basic lead sulphate and zinc oxide, straight from the mixed ore is deserving of careful consideration by the Indian Industry.

The greatest achievement in the line of white pigments has been the introduction of a white derived from Titanium. Almost a Laboratory curiosity some years back, to-day it is a bulk commodity with an annual output of 1,50,000 tons. Its strength, obliterating power, non-poisonous nature, complete inertness and above all versatility opened up entirely new fields for the industry. The raw material used is Ilmenite sand, of which the home reserves are estimated at 75 million tons. The export of the ore from Travancore began in 1922 and has expanded continuously. Attempts have yet to be made for utilising the same in the country. The process is well known. Present research must seek to eliminate impurities and elucidate the precise conditions under which the oxide develops proper pigmentary value. What is further needed is enterprise for starting a large modern plant with careful scientific control and intelligent commercial direction.

Passing on to the coloured pigments the most common are the earth colours. Red oxides of iron and yellow ochres of very good quality are available in the country and their production is continually on the increase. Umber and Sienna, which are of greater value are, however, surprisingly absent. These natural colours have the great advantage of being cheap. But they are available in very few shades. They lack brilliancy, uniformity and high staining power.

The artificial oxides of iron answer the demands of the industry for a better class of pigment materials. Their manufacture could be controlled and standardised. They are in addition much cleaner, possess better body and a finer texture. The synthetic oxides could further be used to tint natural ochres of low grade to improve their staining power. Their methods of preparation fall under two heads, the dry and the precipitation methods. In the dry method, ferruginous materials are calcined under controlled conditions. Precipitated hydroxide of iron is subject to treatments in the second method. Their manufacture merits enquiry. Although an attempt has been made in this direction, a great deal of work has to be done before standard shades of suitable quality are turned out.

The average consumer in most cases is content to buy dry colours and prepare the paint himself. The importance of their manufacture is thus easily realised. Many of the important pigments like Red lead, Prussianblue, Lead chromes, Brunswick green, and chromic oxide green whose manufactures have been attempted, call for increased production and great improvement in quality. The production of blacks of good staining power; cheap alkali resistant blues of the ultramarine type: organic Lake colours fast to light from coal tar dyes—these are lines which if pursued would confer great benefit on the industry.

The finished products of the Paint trade fall under one or other of the following classes: water paints; oil paints; lacquers, varnishes and varnish paints; Anti-corrosion paints; Enamels; Pyroxylin compositions and Synthetic finishes. From the point of view of the Indian Industry it may be useful to consider them under the following heads: (1) Those in which considerable progress has already been made. (2) Those which offer great scope for trial, experimentation and improvement. (3) Those in which there is little prospect of immediate commercial success.

Water paints, oil paints, lacquers, Spirit varnishes and Anti-corrosive compositions come under the first category. Among decorative paints, those thinned with water are the cheapest and deservedly popular. An ideal water paint should not rub off from the surface and withstand washing by water. It must be in dry powder form and miscible with cold water. Most of the commercial brands fall far short of this standard. It has been shown by the author[1] that highly satisfactory products could be obtained by using as binding medium a vegetable protein,—carbohydrate complex and as base, better grades of colloidal

[1] Ind. Pat. No. 20192, 1933.

clays with comparatively small proportions of Lithopone. These have the further advantage of being perfectly non-smelling during application or drying.

Emulsion Paints have always been of interest to the industry. Opinion is undivided as regards their future. The most practicable among them for the Indian market would be the Linseed oil—water-type. The author has succeeded in preparing compositions, suitable for application to wood or metal. These contain boiled or treated Linseed oil medium to the extent of 50% of the water vehicle. The base is Lithopone reduced with Barytes. Zinc oxide is added in some cases in small proportions. The size is a protein—modified cellulose mixture, prepared straight away from indigenous vegetable sources by simple methods.[2] The paint is produced as a stiff paste and softens readily when thinned with water before application. It flows nicely under the brush, covers well and is waterproof.

Such a paint could be obtained cheap and is of importance therefore under present economic conditions. The thinning medium is entirely water. No special costly emulsifier is employed. The size which is formed as a precipitate during preparation is used wet and serves to emulsify the oil and bind the pigments to the surface. Colours, many of which result in wet methods, could be incorporated as such and their drying costs obviated. It must be admitted that as regards weathering properties, a regular oil paint scores over the emulsion one. But it is not always that a complete destruction of the paint film is awaited, for repainting to be undertaken. More often there is a liking for change of colour. The ease of making and brushing of the emulsion paint renders possible to finish the painting with greater despatch and thus save in time and labour. It is not unlikely that it is more economical than the ordinary type, when durability per unit of price is taken into account. Further it dries quick and can be applied even in unfavourable weather. It is non-smelling while applying and leaves little lingering odour. These are highly desirable features particularly in house painting where a minimum of inconvenience to the occupants would be desired. The emulsion paint imparts a pleasing and restful eggshell effect, which in recent times has preference over a bright gloss. The surface however lends itself to further varnishing if desired.

Oil paints have made considerable headway in the country, as their formulation is devoid of much technique. They are produced by grinding together a pigment or mixture of pigments with oil, adding driers and thinning suitably. A great impetus to manufacture has however been afforded by improvements of plant technique. The result has been the introduction of ready-to-use paints of great convenience to the consumer. To-day the demand is for a quick-drying paint and this can be met by many an expensive synthetic finish. Present efforts could therefore be largely directed towards methods of treatment of Linseed oil so as to endow it with quick-setting properties without sacrifice of durability, brushing and storage qualities.

The use of shellac in the industry has received considerable attention for some time. It is a subject in itself, of great importance as lac is a virtual Indian monopoly. Among the products, that in general use is French polish, a varnish for woodwork made up from shellac, a soft resin and methylated spirits. Spirit varnishes yield, with aniline dyes in alcoholic solution, coloured lacquers useful for wood, metal or leather goods. These varnishes could also be incorporated with pigments for production of glossy paints possessing quick drying properties. By far the largest consumption, however, is as Insulation varnish for application in the electrical industry.

In many of these directions lac is threatened by competition from synthetic substitutes. Being laboratory products, their supplies are regular, prices dependable, trade organised and above all, quality uniform. Their properties, largely under scientific control, could be varied to adapt them for purposes on hand. Research measures that have been adopted to resuscitate the Indian trade in lac are directed towards better production and improved manufacture. The aspect of improvement of the quality and quantity of lac has been carried out at the Research Institute at Namkum. More recently the technical side has come in for consideration. It embraces an extended study of the physico-chemical properties of lac, which largely determine its value; devising of methods to rectify the weaknesses of lac so as to meet the needs of the consuming industries; and finally,

[2] Ind. Pat. No. 20143, 1933.

exploring of new avenues for its applications. The close association of the industries, concerned in these studies, is a factor of no mean significance. The results will be watched with interest even by those who wish to preserve the field for demand of the material within the country.

Special paints for protection of iron work are made in large quantities and used. Mention might be made of oxide of iron and red lead paints and the more recent ones containing a metallic pigment like aluminium. Considerable attention has been devoted to the production of bituminous compositions for which sometimes extravagant claims are made. Many of them are compounded from Asphaltum, one or other of the artificial pitches and Linseed oil treated with Litharge, red-lead and a varnish-making gum. The thinner is usually turpentine.

High grade oleo-resin varnishes which would suit actual conditions, are still products of future manufacture. Progress in the line has been inconsiderable as their production is an art in which empiricism is the sole dictator. A varnish is obtained by cooking a drying oil like Linseed, with a varnish-making gum, adding proper driers and thinning. Experience alone can guide in the choice of ingredients and their manipulation, factors which decide the quality of the final product. The raw materials except the resin are found in the country. Success must depend therefore on patient formulations and practical trials.

Specially compounded varnishes serve as media for Enamels. These dry quick and give hard and durable surfaces with permanent gloss. The colours and pigments therein are in a much finer state of division than in ordinary Paints. An enamel which does not thicken and is satisfactory in several respects, can only result from a proper choice of the pigments for incorporation into the media whose preparation is as important. The field is open and offers ample recompense for adequate experimentation.

Synthetic and Pyroxylin finishes are infants in the trade. Though their production in Western countries rivals that of other materials, they are only of subordinate importance in the Indian industry. The Synthetic finishes are based on the manufacture of artificial resins, which could be dissolved in suitable solvents to yield media for paint varnish or enamel. What is aimed here is improvement over the natural products, with regard to adhesion, durability and gloss retention.

Pyroxylin finishes contain as media, low viscosity solutions of cellulose nitrate in various organic solvents together with a plasticiser like castor oil or triphenyl phosphate to render the film flexible. They could be coloured to form lacquers, combined with resins to produce varnishes and incorporated with pigments to give enamel paints.

A great drawback to the use of the above two modern finishes is their expense and as a consequence only a very limited market could be found for them. The problem of the solvents for use—many new ones have been introduced—has yet to be successfully solved by the Indian industry. Further their production calls for special technical skill of a high order. Their manufacture in the country may not therefore be assured of a welcome for some time to come.

"Vernalizing" and Crop Yields.

MR. T. Lisenko, the Russian scientist, announced before the recent Conference of the Soviet Academy of Agricultural Sciences, the results obtained by *vernalizing* a new process for seed regeneration possessing great potentialities for increasing crop yields and insuring against crop failures. The method which is applicable to all self-pollinating plants is to take the pollen from 100 to 200 plants of the same variety, mixing it with a brush and then dropping the mixed pollen into the flowers after bending back the petal-scale with pincers. The seeds obtained are first moistened and then submitted to different degrees of heat before sowing. By this simple process it is possible to obtain plants better adopted to the region than their parents. *Vernalized* wheat matures 3 to 7 days earlier than untreated seed: the treated seed also sprouts earlier. 1,590,000 acres in the Kuibesheff (Samara) Province have been planted with *vernalized* wheat and 1,000,000 acres in the Ukraine Province. In the latter Province, 3,000 acres were planted with *vernalized* cotton seed and the results were, in all cases, satisfactory—the crops developed earlier and the yields were higher as compared with untreated seed.

Research Notes.

The Relation of the Splitting to the Field Strength in the Zeeman Effect of Some Mercury Lines.

THE successful production of high magnetic fields by Kapitza has given rise to new and interesting problems. One of these is the behaviour of the Zeeman pattern of spectral lines in these high fields. Kapitza and Skinner found that in the case of λ 4047 ($^3P_0 - {}^3S_1$) of mercury the separation between the Zeeman components increased more rapidly than the field. Now G. Dupouy and P. Jacquinot (*Comptes Rendus*, 1935, **201**, 543) have studied the behaviour of $\lambda\lambda$ 5461, 4358 and 4047 ($^3P_{2,1,0} - {}^3S_1$) in fields up to 50,000 gauss produced by the large Bellevue magnet. They found that the patterns of 5461 and 4358 were not of similar constitution at different fields. Thus the theoretical pattern of 4358 is $\frac{(1),\ 3,\ 4.}{2}$

The authors now find that the separation between $\pm 3/2$ is proportional to the field strength while that between ± 2 increases more rapidly than the field. Hence they conclude that the separation of the $^3P_1$ level is strictly proportional to the field while that of $^3P_2$ and $^3S_1$ is not. Another interesting point is that the ratio of the splitting of $^3P_2$ and $^3S_1$ is constant. The effect thus found is not connected with the Paschen-Back effect since the fine separation of the mercury triplets is very large. The influence of high order terms in the Larmor precession cannot be a possible explanation since the separation of $^3P_1$ is proportional to the field. The anomaly is thus unexplained.

T. S. S.

Observation of the Brownian Motion with the Unaided Eye.

THE observation of Brownian movement with the unaided eye has recently been considered in a number of papers. The phenomenon observed is a lively shimmering with colour variations seen when a concentrated sol of rosin or solution of gamboge placed between two glass plates is irradiated by strong light from a point source and observed by means of the light it scatters. The eye is to be focussed on the sol. There has been some controversy as to whether the phenomenon is really due to Brownian motion, but E. Kappler (*Physikal. Zeit.*, 1935, **36**, 643) now put forward some reasons for believing that what is seen is really the effect of Brownian motion. Considering two surface elements which are just seen separate by the eye, the brightness and colour of these vary as the concentration of the layer varies on account of the Brownian motion and the diffraction and interference phenomena due to the particles in these surface elements alter. This alteration of brightness and colour gives a sensation of irregular motion. That interference is the cause of the observed colour and light variation is seen from the fact that the sol must be irradiated by a point source while diffuse illumination makes the solution appear uniformly bright. The effect is not visible in or near the direction of the incident rays. The particles of gamboge have to be sufficiently near, that is, a fairly concentrated solution is necessary. When the solution is observed with a microscope with large aperture the ordinary Brownian motion of the particles is observed, the particles appearing dark on a bright background in direct light and as bright points on a dark background in scattered light. In scattered light we find an entirely different appearance when the aperture of the microscope is small. The several particles are no longer seen separate but the light coming from different layers shows a lively variation of colour and brightness. An explanation of these phenomena in terms of Abbé's theory of the image formation by non-self-luminous substances is given in the original paper.

T. S. S.

Use of Direct Current in the Measurement of Electrolytic Conductance.

BRONSTED AND NIELSEN (*Trans. Far. Soc.*, 1935, **31**, 1478) have pointed out the advantages of using direct current in the determination of conductivities of solutions. A simple apparatus is described involving the use of two lightly platinised electrodes which are rendered non-polarisable by bubbling hydrogen through them. This is found to be particularly suitable for the measurement of conductivities of acids and bases. The method described should be of immense use in the measurement of high resistance systems, where the usual alternating current method is not so satisfactory.

M. P. V.

Electrometric Estimation of Traces of Chloride.

THE usual nephelometric procedure for the estimation of traces of chloride present as impurity in reagents is not very satisfactory, as the presence of salts considerably affects the measurements. Furman and Low (*J. Amer. Chem. Soc.*, 1935, **57**, 1585) have described an electrometric method involving the use of silver-silver chloride electrode. A concentration cell is constructed wherein liquid junction is eliminated, by making the solutions into which the two silver-silver chloride electrodes dip identical except that one side of the cell has the chloride of unknown concentration x, and the other side $x + a$, when a is a known weight of chloride added to the solution under test. Traces of chloride of as low a concentration as ·00035 gr. of Cl^- per litre have been measured accurately by this method. This is of quite general applicability, and should be useful for other reversible electrode systems.

M. P. V.

Oil Formation in the Groundnut.

THE progress of oil formation in the groundnut has formed the subject of a study by J. S. Patel and C. R. Seshadri (*The Indian Journal of Agricultural Science*, Vol. V, Part II), who conclude that as the groundnut develops, the percentage of oil gradually increases except in the early stages immediately following blooming and the period just preceding maturity. There is throughout the development of the seed a gradual and uniform gain in oil content and reduction in the free fatty acid content. The harvest of the groundnuts even one week before the kernels are fully mature increases the quantity of free fatty acid and reduces the oil content by about five per cent. The high free fatty acid content in the groundnut reaching England from the Coromandel Coast ports and from Calicut which goes up as high as 11% and therefore reduces its quality and price very considerably, is surmised to be partly due to the practice of harvesting the groundnuts before they are fully mature. It is significant that Marmagoa and Bombay shipments which include the crop from the Mysore State are strikingly low in their fatty acid content being only about 2·5 per cent. at the most.

Photo-Oxidation of Sulphur.

EXPERIMENTS by Fazal-ud-Din (*The Indian Journal of Agricultural Science*, Vol. V, Part II) establish that elemental sulphur undergoes oxidation by mere exposure to light which thus becomes an additional agency to bacterial and chemical oxidation. The photo-oxidation is also found to be greater in the presence of certain catalysts such as zinc oxide, animal charcoal, and soil, the action due to zinc oxide being however negligible when compared with the other two. In these latter, the oxidation proceeded even further when light was excluded. In an alkaline medium the oxidation was slightly higher. In soils rendered sterile as regards sulphur oxidising bacteria, the photo-oxidation was very much slower than in soil not rendered sterile. It would be interesting to study the extent of the solubility of the phosphate in animal charcoal or bonemeal mixed with sulphur and treated in the most favourable manner for photo- and bacterial-oxidation of the sulphur.

Oxidation of Fats in Animal Tissues.

IN the course of two important papers appearing in the *Biochemical Journal* (1935, **29**, 2143–86), Jowett and Quastel have made a critical study of fat metabolism by employing an *in vitro* method, which takes advantage of the previous observation (Quastel and Wheatley, *Biochem. J.*, 1933, **27**, 1753) that fatty acids are oxidised at considerable rate by slices of liver, giving as one of their oxidation products acetoacetic acid as in the body; the acetoacetic acid is estimated by the manometric method of Warburg. A study of the kinetics of the oxidation of butyric, crotonic, β-hydroxy butyric acids by the liver of the Guinea pig, has shown that the rates of oxidation are in the order cited, being highest for butyric. The variation in the rate of oxidation coupled with the observations that propionate and cinnamate while inhibiting the oxidation of butyric and crotonic acids, possess no effect on the oxidation of β-hydroxy butyric acid, rules out the view previously held that the mechanism of oxidation of the three acids are interrelated. The view that β-hydroxy butyric acid is an intermediate product is also untenable; in fact the indications are that this acid is produced from acetoacetic acid. It is however probable that crotonate passes through

butyrate as an intermediary. It is even more probable that the process of oxidation to acetoacetate takes place after adsorption on the surface of one and the same enzyme which effects the complete process with both butyrate and crotonate.

In the second part, the authors have extended the studies to the oxidation of normal saturated fatty acids containing from 2 to 10 carbon atoms. In the first place, it has been shown that there is a relation between the increase in acetoacetic acid production and the increase in respiration brought about by the fatty acids, a relation which is characteristic for each acid. There is also a characteristic difference between the behaviour of acids with even and odd number of carbon atoms, the latter being more completely oxidised in the liver. Acetoacetic acid is probably the only β-ketoacid produced in significant quantities by the oxidation of fatty acids. The β-oxidation theory of Knoop is inadequate to explain all the observations quantitatively. The observation that benzoate strongly inhibits the production of ketonic bodies from butyrate, while the inhibition is less with higher fatty acids, suggests that butyric acid is not an intermediary in the breakdown of higer fatty acids as demanded by the theory of Knoop. The authors propose a "multiple alternate oxidation" theory according to which the fatty acids undergo, at a common enzyme, an oxidation throughout the fatty chain, alternate carbon atoms being affected. The oxidised product then breaks down, and the ultimate production of acetoacetic acid and other acid products. The theory is somewhat speculative, and further developments are keenly awaited.

Iron Gallate Inks—Liquid and Powder.

ZIMMERMAN (*Journal of Research of the National Bureau of Standards*, 1935, **15**, 35) describes experiments carried out with a view to prepare inks and ink powders which would not only satisfy the requirements of the U. S. Government Standard writing ink but at the same time be less corrosive on steel-pens.

The effect of gallic and tannic acids on the stability of inks was studied quantitatively by noting the period which elapsed before any sediment was observed.

The substitution of ferric sulphate for the ferrous sulphate in the preparation of ink was found to result in increased corrosive action on pens, but it was also found experimentally that addition of oxalic acid (about 3g/L) to ink so prepared, not only reduced its corrosive action considerbly, but also increased its stability. Oxalic acid, however, accelerates deterioration of paper, and so such ink is unsuitable for making permanent records.

Three '*formulas*' are suggested in a tabular form for the preparation of ink, either liquid or powder.

K. R. K.

Separation of Petroleum Hydrocarbons with Silica Gel.

IN a paper published in the *Journal of Research of the National Bureau of Standards* (1935, **15**, 51), Mair and White have presented the results obtained in a study of the efficiency of silica gel as an adsorbent of some types of petroleum hydrocarbons with a view to its application to the important problem of the separation, identification and determination of the constituents of petroleum.

Two grades of silica gel were employed, one being 40–200 mesh, and the other 200 mesh and finer. The silica gel was kept at the lower end of a glass tube and served as a bed through which the hydrocarbon mixture filtered at a predetermined rate.

Adsorption experiments with the following systems were performed: (1) mixtures of an aromatic and a naphthene or a paraffin hydrocarbon, (2) mixtures of a naphthane and a paraffin hydrocarbon, (3) petroleum distillate boiling between 140 and 145°·5 C.

The results of these experiments show (*a*) that there was a complete separation of the aromatic and olefin hydrocarbons from paraffin and naphthene hydrocarbons, (*b*) that the gel showed a tendency to adsorb the naphthenes in preference to the paraffins, (c) that there was a slight separation of normal paraffin hydrocarbons, the paraffin of low molecular weight being adsorbed in preference to that of high molecular weight.

It was also established that in none of the experiments carried out did the silica gel crack or otherwise attack any of the hydrocarbons employed.

A simple and efficient laboratory method (98 per cent. recovery) employing silica gel is suggested for the complete removal of aromatic from naphthene or paraffin hydrocarbons.

K. R. K.

Oogenesis of Acentrogobius Neilli.

M. K. SUBRAMANIAM AND R. GOPALA AIYAR have published the results of their investigations on the vitellogenetic activity in the ovum of Acentrogobius Neilli (*J. Roy. Micr. Soc.*, September 1935, **55**, Pt. 3) in which they record that the Golgi apparatus which makes its appearance in the young oocyte in the form of a single dense mass in the neighbourhood of the nucleus. Later the mass is seen to break up into a number of minute grains which migrate towards the periphery. Fatty yolk is formed from them. The mitochondria which are at first in the form of a circumnuclear ring later become dispersed. The authors are definitely of opinion that they do not take any part in deutoplasmogenesis. A nucleolar origin of fat is described. Even in the earliest stages the nucleoli are multiple and as growth proceeds they move towards the periphery of the nucleus. The authors have put forward the novel suggestion that even within the nuclear membrane the nucleoli become lipoid and while there is no evidence of their migration into the cytoplasm, presence of fat globules outside the nuclear membrane adjacent to the nucleoli which have now taken up a perinuclear position has been adduced as evidence for the nucleolar origin of fat.

A Hitherto Undescribed Piroplasm of Goats (*Piroplasma taylori*).

EARLIEST record of piroplasma in sheep was made in Roumania by Babes in 1892. Since then various workers have recorded the presence of piroplasma in the blood of sheep and goats. In India only two records are available—one from Muktesar among goats and the other from Mysore among sheep. Sarwar (*Indian J. Vet. Sci. and Anim. Husb.*, 1935, **5**, 171–176) has observed a piroplasm in goats which does not agree in any way with the description of the hitherto recorded species. Its morphological features are suggestive of its being a new one. The parasite was obtained during post-mortem examination on a goat.

The infected red blood corpuscles are distinctly enlarged in size proportionately with the number of parasites occupying them. The parasite divides into two or multiples of two at the same time. From 2 to 16 elements have been noticed in the red blood cells.

The author proposes the name "Piroplasma taylori" to the new species of piroplasm.

S. D. A.

Bovine Surra in India.

Indian cattle and buffaloes generally are found to possess a much higher degree of resistance to Surra than equines and they often harbour the parasites in their blood without evincing any evidence of disease. But some outbreaks have been noted in the Punjab and Hyderabad State where the disease has proved fatal to the animals.

Krishna Iyer and Sarwar (*Indian J. Vet. Sci. and Anim. Husb.*, 1935, **5**, 158–170) refer to an outbreak at the Imperial Cattle Farm, Karnal, where 12 animals were affected and 4 died out of 176 animals on the farm. The disease was observed to be more severe in bullocks and young male animals, whereas in cows, the disease appeared in a milder form, and none of the affected cows died.

Various drugs such as Atoxyl and Arsenic, Chiratta, Neem leaves, "Bayer 205", Tartar emetic and Naganol have been tried by various workers. The authors claim successful results by treating the affected with 10 to 30 c.c. of a 10 per cent. solution of "Bayer 205" intravenously.

The authors have discussed the transmission of Surra by invertebrate vectors. The abnormal contents of two Bdellolarynx flies were found to contain trypanasomes immediately after they had fed on infected animals.

T. evansi is the specific protozoa that caused Surra in this outbreak.

S. D. A.

Ciliates from Indian Mammals.

A NUMBER of papers on Ciliates Protozoa belonging to the family *Ophryoscolecidæ* have been published recently. Prof. C. A. Kofoid visited India as far back as 1916, and made a large series of preparations of Ciliates from *Bos indicus*, *Bos gaurus* and *Elephas indicus*. Those from *Bos indicus* have been exhaustively studied by Kofoid and MacLennan in a series of monographs (1930–33) which have been already noticed in this Journal (*Curr. Sci.*, 1935, **4**, 13-16). Kofoid and Christenson (*Univ. Calif. Public. Zool.*, 1934, **39**) have described 25 species belonging to 8 genera from the stomach of the gaur. Of these, 11 species are the same as already

described from the Indian ox, and 9 species identical with those already recorded from domestic cattle, etc., in other parts of the world. Five species, *viz.*, *Entodinium contractum*, *E. curtum*, *Metadinium rotundatum*, *Ostracodinium mysorei*, and *O. gauri* are new to science. These Ciliates from the wild relict member of the ox tribe show no primitive characteristics, being as complex in their evolutionary tendencies as those from other domesticated ruminants. The two species described by Kofoid (*Proc. Nat. Acad. Sci., Washington*, 1935, **21**) from the cæcum and colon of the elephant are very remarkable indeed. *Polydinium mysoreum* and *Elephantophilus zeta* not only belong to new genera, but have to be placed in a new subfamily. In other genera of *Ophryoscolecidæ*, known so far, there is either the adoral zone of membranelles only present, or a second dorsal zone in addition. The members of the new sub-family, *Polydiniidæ*, are characterised by the presence of numerous accessory membranelle zones extending over the considerably elongated body. These zones instead of being dorsal are divided bilaterally in two groups, and thus a secondary bilateral symmetry is superposed upon the primitive spiral one.

M. Das-Gupta from the Department of Zoology, Calcutta University, has published an interesting record of Protozoa from the rumen of the goat, *Capra hircus* (*Arch. Protistenk., Jena*, 1935, **Bd. 85**). Besides 1 rhizopod and 6 flagellates, no less than 36 species belonging to 11 genera are recorded with brief notes. Of these latter, four are described as new species of *Entodinium* and 13 species belonging to several genera are believed by the author to be new records from the goat. What a wealth of material is at hand in such a common animal as the goat!

The Ciliates from the horse, sheep, and camel have not yet been studied in India so far.

B. L. B.

The Y-Granules in Insects.

SINCE the discovery in Saccocirrus of a group of granules allied microchemically to yolk, attempts have been made to find them in other animals and J. A. Muliyil's work, on a number of insects (*J. Roy. Micr. Soc.*, September 1935, **55**, Pt. 3) has revealed their existence. Most cases can be demonstrated by the employment of neutral red though this is by no means the most specific method. In a few cases, a single homogeneous body later breaks up to give rise to the characteristic granules. Evidently their function is not known and they are eventually cast out during spermateleosis.

Malpighian Tubules in Melanoplus.

R. R. STUART describes the structure of the malpighian tubules in the grasshopper Melanoplus (*J. Morph.*, 1935, **Bd. 58**, No. 1, p 173). There are about 192–312 malpighian tubules, collected into twelve bundles. Each bundle opens into an excretory ampulla. Each tubule is composed of large polygonal cells. The ampulla consists of an inner mass of unchitinised epithelium and a layer of chitinised cells. These two are separated by a narrow irregular lumen. The epithelium of the cephalic intestine is thrown into 12 long folds.

The Mineralogical Classification of Igneous Rocks: A Comparison of Recent Proposals.

IT is well known that the want of a standard method of classification of igneous rocks has rendered the task of many petrographers difficult, more so in recent times where each author favours his own type of classification. In comparing the mineralogical with other types of classification S. J. Shand (*Journal of Geology*, **43**, No. 6) has put forward a strong plea for evolving one common type of classification. Shortly reviewing the works of Iddings, Winchell, Holmes, Niggli and Grout, Shand has shown that there is a general tendency to accept two instead of three textural divisions as a basis for classification. With the increasing recognition of colour index, and the use of actual instead of calculated felspar, it is possible to develop a fairly comprehensive classification; and if leading petrographers come to an understanding on these points, it will be a great relief to many workers in their every-day work, leaving the other types of classification for specialists desiring to institute broad comparisons for purposes of regional geology.

The Fifth Congress of the International Society of Sugarcane Technologists.

The Meetings and Excursions.

THE above Congress met at Brisbane in Australia from the 27th August to 3rd September, 1935—the meetings being divided into various sections such as Agriculture, Breeding and Sugarcane Varieties, Methods of Field Experimentation, Sugarcane diseases and various aspects of the factory. The Congress was well represented, the members who answered the roll call hailing from all the important sugarcane countries of the world—Hawaii, Lousiana, Porto Rico, West Indies, Cuba, United States of America, Peru, South Africa, British India, Java and others.

The State Government of Queensland, the Commonwealth Government of Australia and the various sugar interests in Australia, all combined to make the delegates feel quite at home in that interesting country. At the end of the Congress meetings at Brisbane a special train took the delegates into the various plantations and sugar factories. This tour which lasted almost a fortnight was very interesting as bringing the delegates into close contact with a Sugar Industry which has certain very interesting features to the visitor from abroad.

THE SWEETEST CANES IN THE WORLD.

Australia is adjacent to New Guinea which is believed to have been the home of at least one race of the sugarcanes in cultivation and the dominant cane in cultivation in Australia to-day is Badila—one of the original types found in New Guinea. The breeding of new canes from seed has been in progress in Australia for some time and has resulted in types suited to special conditions; but in the best cane lands Badila still holds its own. This cane has been tried in various parts of India, but it has shown its usefulness only in one locality in South India—in the factory plantations at Nellikuppam.

Australia also grows the sweetest cane in the world and the sugar recoveries are higher than in most other countries due chiefly to the quality of raw material. The general trend of opinion at the Congress indicated the set of climatic conditions in Australia as the chief factor contributing to this superior quality. It was found that the same variety showed better juice quality in Australia than elsewhere. The Coimbatore cane—Co.290—which is proving useful in Australia chiefly on account of its marked resistance to the diseases common in Australia, shows better juice quality in Australia than in India.

CROP GROWN WITH 100% WHITE LABOUR.

But perhaps the greatest interest of the Australian industry to the visiting delegates lay in its being run on a "White Australia" policy and the adjustments arising out of it. At present only white labour is employed in the sugar factories and plantations. The standard of living in Australia is said to be higher than in most other countries and the white labourer in the sugar plantations in Australia is entitled by law to receive as wages 16 shillings (Australian) per day, which is almost equivalent to about half a month's wage in Java and India.

This has led to a marked development in labour-saving machinery and this was prominently brought to the notice of the delegates during the itinerary after the Congress meetings. From the time of planting—which itself is done by machinery—right to the harvest the machine does all the field operations including weeding after cultivation, application of fertilizers, etc. As to harvesting machinery, though one was demonstrated in one of the largest plantations, the mechanization of this part of the operation has not yet been a complete success.

A WELL-PLANNED INDUSTRY.

The whole industry in Australia is run on a thoroughly planned basis, which naturally involves control at various stages either by Government or Pseudo-official bodies like the Sugarcane Prices Board set up by Statute. The area from which the factory is to derive its supplies, the wages to be paid to the labourer, the working hours for labour —including a factory holiday on Sunday— the price to be paid to the cane and the rate at which sugar is to be sold in the country, are all fixed.

AUSTRALIAN SUGAR WELL PROTECTED.

It was certainly most interesting to learn that whereas the price of sugar per lb. in Australia was 4*d*., the same Australian sugar sold in the London markets fetched only about 1½*d*. Though Australia loses about £ 6 to 8 (Australian) on every ton of sugar exported, ample justification for maintaining the industry is found (i) in finding employment for the Australian white population and that too at a high standard of

living, (ii) in populating the rather vulnerable North Queensland, and (iii) in supplying the country with home-grown sugar.

The profits of the industry appeared to be better distributed than in most other countries and one marked feature was the fair number of factories owned by the growers themselves on a co-operative basis.

DIFFERENT STRAINS OF THE SAME DISEASE.

On the scientific side, discussions at the Congress brought out many points of interest. The papers presented indicated almost unmistakably the possible presence of different biological strains or pathogenic types of one and the same disease. This has an important bearing on the transport of new canes from one place to another and on the methods of disease-resistance trials.

USE OF *Saccharum Robustum* AS PARENT.

Saccharum officinarum when crossed with *Saccharum spontaneum* (male parent) doubles its chromosome on the mother side. No such doubling takes place when *S. officinarum* is crossed with *S. robustum*. This opens up a new line of work in Sugarcane Breeding so far at least as the tropical sugar world is concerned. Sugarcane breeding has gained greatly by the use of *S. spontaneum* as one of the parents. The use of *S. robustum* has not yet been exploited and there are indications from Hawaii that for Hawaii, at any rate, the use of *S. robustum* is likely to be useful. The delegates—including Dr. Brandes, the discoverer of *S. robustum*—saw in one of the Breeding Stations in Australia certain promising seedlings obtained from the mating with *S. robustum*.

MANY DISEASES KEPT UNDER FULL CONTROL

Similar interesting facts emerged from the discussions in the other Sections as well. But one fact which impressed the Congress as a whole was the very successful manner in which the various cane diseases had been controlled in Australia by suitable organization of control measures and growing resistant types. So efficiently has this been done that, though in the first circular it was mentioned that pathologists would have an opportunity to see many diseases, in the actual visits to the plantations it was difficult to get good specimens of the same.

The Congress was fortunate in having the presence of such a distinguished sugar-man as Dr. C. A. Browne, who was specially honoured by the Congress at its full session. The next Congress is to be in Louisiana in 1938 under the General Chairmanship of Dr. E. W. Brandes, the well-known head of the Bureau of Plant Introductions, United States of America.

The Shape and Size of the Earth.*

THE fundamental problem of geodesy is the accurate determination of the form of the Earth or the deviations of the actual geoid from the international ellipsoid and also study the dynamic causes that bring about a change in this form, the guiding principle being the principle of isostasy.

The problem of the determination of the form of the earth resolves into the following :—

(1) Observation of the mean levels of the sea ; therefore a study of the tides in the oceans at different places.

(2) Observation of the surface inequalities. This involves levellings to determine the height, etc., by means of spirit levels and telescopes.

(3) Determination of distances on the earth in different directions. This is done by a system of triangulations by means of chains of standard lengths made of invar to determine the distance of two stations along what is called a straight *base line*. A precision theodolite enables the position of a third station to be observed from the first two by noting from each the angular separation of the two other stations. This is extended through a large number of stations to those hundreds and thousands of miles distant. By assuming a mean form of the geoid the longitude and latitude (geophysical) could be measured with respect to a standard station, chosen centrally.

(4) Determination of the astronomical latitude by observation of the azimuths of two stars one on either side of the zenith, or vertical or plumb line, at the place of observation by means of telescopes.

(5) Determination of the astronomical longitude by observing the local time by the transit of stars over the meridian and simultaneously getting by means of accurately adjusted chronometers or time signals times

* The Survey of India, Geodetic Department, 1934.

from some place of reference whose longitude is assumed.

(6) Comparison of 4 and 5 with 3 gives an expression of the deviation of the plumb line, or of the direction of gravity from the vertical (the perpendicular to the international spheroid or whatever general geoid that fits best). This gives gravity level surfaces.

(7) The curvature of the plumb line measured by the torsion balance of Baron Ötvos. One type of this balance in which two equal weights are attached to the ends of a beam suspended at the middle with a quartz fibre gives the gradient of the gravity deflection along two directions. A second type in which one weight is above and the other equally below the beam enables the gradient to be measured in magnitude as well.

(8) Determination of the absolute intensity of gravitation at different places by means of pendulums.

(9) Determination of the intensity of gravity on sea, by means of a barometer to be read correct to 0·01 mm. and determination of boiling point of pure water to an accuracy of 0·001° C., in that with change of gravitational intensity alone the pressure read off remains the same, the boiling point however indicates the change.

(10) Purely astronomical measurements of the precession of the equinoxes. They enable the form of the earth to be calculated. If the earth were perfectly round, there would be no precession.

The determination of the accurate form is of utmost importance in the location of mineral resources such as ore, coal, oil, etc., even when hidden deep in the crust, because these minerals are pretty sharply distinguished from the rest of the crust by their density so that measurement of plumb line deflection gives the wanted clue. Almost every government has established departments of its own for such measurements. The Geodetic Branch of the Survey of India, Head Office Dehra Dun, is in charge of these measurements in India. The Survey of India is an old institution. The Great Trigonometrical Survey was started in 1800. From 1922 the annual reports are published in three separate volumes of octave size, *viz.*, (1) General Report which is confined to reporting the Survey operations of the ordinary field parties and detachments with only brief abstracts of Geodetic operations, and Map Publication and Office Work. Published annually. (2) The Map Publication and Office Work Report which contains all the Index Maps showing the progress of Map Publications on all scales, with reports on publications and issue. Published annually beginning with year 1924, price Rs. 3. (3) Geodetic Report which includes full details of all scientific work of the Geodetic Branch, Survey of India. From 1933 inclusive, the General and Map Publication and Office Work Reports have been confined into one report under the title of General Reports at Rs. 1–8–0.

Triangulation, levelling, gravity, deviation of the vertical and predictions of tides have been the main features of the Geodetic Reports of every year. Preparation for the international longitude project began in 1925–26 and was receiving the attention of the Department in years 1926–27 and 1934, magnetic measurements were made in 1925-26. In 1930–31, a Magnetic Survey was included. In the 1934 report (the latest) Chapter I, devoted to Triangulation and Base measurements, are given results of measurements of three base lines, one in Baluchistan, second in Poona and the third in Assam and the order of accuracy discussed (1 in about 600,000), the best hours for observation of the horizontal angles found to be either morning or evening. Levelling parties worked mostly in Burma and Northern Shan States. Late in the year three double detachments and eight single detachments were formed for levelling the Bihar Earthquake (Jan. 15, 1934) area. Bench marks showed shrinkages up to 4½ feet and only four cases of elevations were observed of which the largest is 0·029 feet. The largest sinkages occurred in structures which had presumably sunk into the ground, and the embedded bench marks generally show smaller change although one case of 2·7 feet was observed.

Chapter III gives the results of pendulum experiments for the intensity of gravitational attraction in Ceylon, and in the Maldive and Laccadive islands. Gravity results of Ceylon show a satisfactory agreement with the geology. They suggest that the tilted syncline (folding in ellipsoidal, paraboloidal surfaces with same sign for the principal curvatures) of the island is unsymmetrical as it is distorted in the region of the Adam's Peak. In the Maldives evidence supports the theory that those coral islands are formed by gradual subsidence of the ocean bed due

to isostatic adjustment. Work at Minicoy leads to the interesting conclusion that the Laccadive islands are tectonically different from the Maldive islands.

Two detachments were employed on tracing sections of the geoid by means of stations at close intervals by observing both components of the deviation of the plumb line. One worked from Assam–Burma frontier through Bengal to Bihar. In 1934–35 it is expected to push this up to Agra and to observe in Sindh and Baluchistan. It is expected that by 1935–36 the whole section from Persia to Indo-China would be completed. The second detachment observed latitude only between Cape Comorin and Hyderabad (Deccan). The observations of the Siamese Survey have been made use of along with those of the Indian and the geoid calculated. The radius of curvature of the east-to-west section 2,500 miles long is 700 feet greater than that of the international spheroid, while the curvature of a 2,000 miles north-to-south section 1,500 feet less than that of the international spheroid. It is suggested that the geoid of South Siam is 100 feet higher than any geoid that fits in with those two arcs and that therefore South Siam shows some departure from isostatic equilibrium. This might lead to some earthquake in the near future.

In Chapter VIII on research notes, conversion maps are given showing the heights of the International Spheroid over the Everest Spheroid used by the Geodetic Survey, as well as over that of its spheroid II used since 1928. The short Chapter VI gives the value of longitude observed at Dehra Dun for the International project arranged by the Burma International de l' heure at Paris, working with four different instruments. Standardisation measurements are given in Chapter VII. Tide predictions from observations at 14 ports are given and the accuracy discussed.

B. DASANNACHARYA.

The Geology of Ceylon.*

THE island of Ceylon constitutes largely a continuation of the main geological formations of Southern India. Like the adjacent mainland it consists of large masses of ancient crystalline schists and narrow fringes of some of the later sediments deposited along the coastal strips.

Mr. J. S. Coates has recently published an account of the geology of the island, based on the results of his traverses over the greater part of the country, supplemented by numerous scattered observations which he had been able to make while engaged as Government Mineralogist. According to him nine-tenths of the island is occupied by the Archean crystalline schists with only a few narrow belts of sediments along the coast. The sequence of rock formations as given by the author is as noted below :—

Post Tertiary,
Miocene,
Jurassic,
Archean.

The *Jurassic* rocks are described as forming an insignificant series occupying a small area of less than a square mile in extent. They are found exposed near Tabbawa, at a distance of about 80 miles N.N.F. of Colombo, and form a series comprising of conglomerate, grits and sandstones, shales and nodular limestones attaining an estimated thickness of about 2,000 feet. The sandstones and shales are unfossiliferous, but impressions of a number of plant relics have been found in a clay bed. Amongst them, many of the identified species seem to be of lower Oolite and Upper Liassic horizons and correspond to the plant fossils recorded from the Madras Coast.

The *Miocene* rocks form the entire peninsula of Jaffna and they are also seen as narrow fringes in the north-west coast, extending to a width of about 10 to 12 miles inland. This formation consists mainly of fossiliferous limestone succeeded by a series of sandy argillaceous beds and mottled sandstones. The fossils from the Jaffna limestone include several identifiable species of molluscs and foraminifers. The palæontological evidence leads to the conclusion that this series of rocks of the north-west Ceylon are identical with similar rocks at Quilon in Travancore, and are of an older age than those of Karikal on the Coromandel Coast of India.

Pleistocene and Recent.—These post-tertiary formations consist of various types of coastal deposits, including sandstones, coral

* "The Geology of Ceylon," J. S. Coates. *Ceylon Journal of Science*, 1935, **19**, Sec. B, Part 2.

deposits and blown sand, a detailed account of which is given by the author.

Archean.—The Archean formations of Ceylon like those of the Peninsular India show a great variety of groups which are described under the following names:—

(*a*) *Bintenne gneiss.*—This name is given to a series of complex banded granitic gneisses covering an extent of about 5,000 square miles of the island in its south-eastern part. The biotite gneisses of this complex are noted to show very variable strikes, but they seem to dip consistently, especially in the eastern Bintenne area, everywhere conformably under the "Khondalite" rocks, forming possibly the floor on which the great masses of the latter group were laid down. The gneisses of this group form a composite series without any perceptible clear lines of junctions to enable one to separately classify and map the individual components. The Bintenne gneiss recalls certain features characteristic of similar gneisses of other Archean terrains, but it differs from the Bengal gneiss of India in having no intercalated beds of limestone or dolomite and also in containing very few accessory minerals.

(*b*) *Khondalite series.*—An extensive series of schistose and gneissic rocks comprising quartzite or granular quartz rock as its principal member, fissile quartz schists, finely banded quartz-felspar gneisses with or without biotite and garnet, impure crystalline limestones and a variety of garnet sillimanite schist, form among themselves a distinct group separable from the other gneisses of the island. They are confined almost to the central part of the island, covering an area of about 5,000 square miles.

They have a general resemblance in appearance and character to the great masses of the garnet-sillimanite-graphite schists or the "Khondalites" of the Kalahandi State in the north-east part of the Peninsular India. In Ceylon, varieties corresponding to the typical "Khondalites" of Dr. Walker, are rather rare, and many of the types differ from them generally in containing felspar and in not having graphite. The associated crystalline limestones or marbles, especially the darker varieties, contain abundant silicates like olivine, dark pyroxene, tremolite and pale phlogopite. Clinohumite is also found at certain places as a conspicuous constituent of these limestones. Pyrite, graphite, magnetite and spinel are some of the non-silicate minerals usually present.

The series with its intercalated bands of Charnockite is estimated to have a total thickness of some 30,000 to 40,000 feet. The rocks of this group, like the Khondalites of Peninsular India, are believed to have originated from the metamorphism of a series of sediments consisting of limestones, shales, sandstones and arkoses.

(*c*) *Kadugannawa gneisses.*—Bounding the western edge of the "Khondalite Series" in the central part of the island, is another series of rocks which outcrop as a thick lens of about 30 miles in length north and south and 8 miles across the thickest part, gradually tapering away at both ends. The types forming this complex are dense, black, glittering hornblendic rocks with more or less biotite and felspars, and comprise of banded, massive and schistose varieties. Some of the narrow bands are stated to contain mainly of pyroxene, while calcite seems to be always present. Attention is drawn to the close resemblance of these Kadugannawa gneisses to the calc gneisses of Fermor. The descriptions of these types as given, seem to fit in also with the types described as secondary pyroxene rocks or Tarurites from the Mysore State. The gneisses are regarded as metamorphosed calcareous sediments of probably the same age as the Khondalite Series.

(*d*) *Charnockites.*—The series of granulitic hypersthene rocks, comparable to the well-known "Charnockites" of Southern India are found widely distributed in Ceylon. They reach their greatest development in the south-west quarter of the island where they seem to be continuous over an area of about 4,000 sq. miles. They are also found as numerous thick sills between the schists of the Khondalite Series. Isolated exposures are found in other gneissic areas as well. Acid, intermediate, basic and ultrabasic types all seem to be represented.

The Charnockites of Ceylon are stated to differ from the Indian Charnockites in certain respects, *viz.*, in the almost complete absence of microcline, the widespread distribution of calcite, the prevalence of micaceous types and in the intercalation of numerous bands of garnetiferous leptynites.

Wanni gneisses.—A distinct group of reddish, pink or buff coloured gneisses and granulites of intrusive appearance is found in the northern half of the island. The

different types of this series are all characterised by (1) the paucity of ferro-magnesian minerals, (2) the abundance of magnetite, and (3) the comparative abundance of monazite.

These seem to correspond petrologically to some of the newer granites or gneisses of Peninsular India which have been found intruding the Charnockites.

Pegmatites and basic dykes are also found and among the latter, dolerites, peridotites and pyroxene scapolite dykes have been noted.

Among the economic minerals found and worked in the island, graphite, various gem stones, mica, thorianite, monazite and zircon sands are the most important.

B. R. R.

Diet and Climate.*

DR. CHICK'S "Cantor Lectures" on "Diet and Climate" cover a wider field than their title indicates. While she deals at length with the specific question of ultra-violet light and sunshine in relation to vitamin D, calcium metabolism, rickets, osteomalacia, etc., she has included also sections on diet as influenced by locality, race, and custom. In the first lecture she points out that one of the first important clues as to the cause of rickets was found in the study of its seasonal incidence and geographical distribution. As long ago as 1890, Theodore Palm put forward the theory that rickets is a disease of sunless places. His theory, broadly speaking, was correct, but it was not until over 30 years later that the reason *why* rickets tends to be a disease of sunless places was discovered. The explanation, which is at once remarkable, unexpected, and completely satisfying, was provided during the years 1918–30 as a result of the labours of many investigators working independently at different aspects of the problem in their respective countries. No single worker can claim credit as the discoverer of the cause of rickets.

Dr. Chick comments on the existence of rickets, and especially osteomalacia, in Northern India and China. In these regions there is plenty of sunlight capable of transforming the eyesterol normally found in the skin into vitamin D, but there exist "social customs which hinder access to fresh air and sunshine for women and children". At the same time there tends to be a deficiency of mineral salts in the diet. "Vitamin D can only control and correct the metabolism of lime salts and phosphates if these are present in adequate quantities in the diet; sunshine can only provide vitamin D if the inhabitants take advantage of the supply thus provided."

Wilson has shown that rickets and osteomalacia occur in Kashmir even in villagers fully exposed to sunlight. Here, it seems, the chief factor in the causation of these diseases is mineral deficiency rather than lack of vitamin D. The administration of tri-calcium phosphate has proved more effective in treatment than cod liver oil. As a result of the lack of calcium salts and phosphates in the diet, vitamin D, derived from sunshine, is unable to fulfil its proper function.

The lecturer emphasises the association between a high intake of milk and its products and good physique. As McCollum has remarked, "Wherever dairy animals are abundant in proportion to the population and their products form a staple article of diet, fine physical development is seen without exception." In India, McCay was the first to suggest a relationship between the physical characteristics of the various peoples and their staple diet. His investigations have been confirmed and extended by McCarrison, and precisely parallel observations have been made by workers in other parts of the world—notably by Orr and Gilks in East Africa. In England it has been amply demonstrated that an improvement in national physique could be brought about by an increased consumption of "protective" foods, notably milk.

Dr. Chick concludes with some wise remarks about the need for common sense in applying in practice the scientific principles of nutrition:

"A great deal of exact knowledge is now available and ready to be applied, but dietetics is not an exact science, and the application of the science of nutrition to the art of dietetics needs to be made with common sense and with intelligent adaptation to the particular circumstances. For example, it is vital that the Madrassi peasant or the Malay coolie should be weaned from rice

* The Cantor Lectures. "Diet and Climate" by Harriette Chick, C.B.E., D.Sc., *Journal of the Royal Society of Arts*, Sept. 13 and 20, 1935.

that is highly milled and polished and persuaded to take it with the bran and germ adhering to the grain. But it is not only silly, but also misleading, to tell the poor English working woman that she must pay more to secure 'unpolished rice' for her occasional rice pudding. In any case, the milk in the pudding and the egg, if present, will correct the deficiency of the highly-milled rice, even if the effect of other constituents of the diet is disregarded.

The use of pasteurised or boiled milk is another example. Milk so treated has a slightly impaired nutritional value, it loses most of its antiscorbutic value, which is never great, and some portion of its content of lime salts is converted to a less digestible form. In this country, however, the heating of milk before consumption is a necessity, since the danger of milk-borne disease is so great. Tuberculosis alone is widespread among our dairy cattle and is a menace to children taking large amounts of raw milk. Yet there are people who insist on the need for raw milk on dietetic grounds, although the defects in heated milk can be simply repaired by giving a little extra fruit juice or vegetable food.

These examples will suffice to show the need for common sense, and the dangers of faddism, in applying the results of scientific investigation to the practical problems of diet.

There remains the economic difficulty of providing a perfect diet upon inadequate means. The provision of cheap milk for school children by the local authorities is an important step in the direction, and other ways of encouraging the consumption of dairy products should be welcomed. In any case, the spreading of knowledge and the popularising of the less expensive 'protective foods' should do much to secure improved nutrition for our own population."

W. R. A.

Andrew Carnegie.

THE Centenary of the late Andrew Carnegie will be celebrated on November 25, 26 and 27 in New York, Pittsburg, Washington and other cities, according to an announcement made by Dr. F. P. Keppel, President of the Carnegie Corporation of New York, the largest of the six Carnegie Foundations in the United States.

Andrew Carnegie was born on November 25, 1835, in a weaver's cottage in Dunfermline, Scotland, the ancient Caledonian capital from which his family emigrated to America in 1848. It was in Dunfermline that Carnegie built his first library and began in 1881 his series of library benefactions that continued until 1917, by which time he had built 1,946 free public libraries in the United States and 865 in other parts of the English-speaking world.

The six Carnegie trusts in the United States are: Carnegie Institute of Pittsburg (1896) which conducts an Institute of technology, a museum of fine arts, a music hall, a museum of natural history, a public library and a library school; Carnegie Institution of Washington (1902) devoted to scientific research; Carnegie Hero Fund Commission (1904) to recognise heroic acts performed in the peaceful walks of life; The Carnegie Foundation for the Advancement of Teaching (1905) to provide retiring pensions for teachers and to advance higher education; The Carnegie Endowment for International Peace (1910) to serve the purpose indicated by its name; and Carnegie Corporation of New York (1911), for the advancement and diffusion of knowledge and understanding among the people of the United States and the British Dominions and Colonies.

The four British Carnegie Trusts are: Carnegie United Kingdom Trust; Carnegie Dunfermline Trust; Carnegie Trust for the Universities of Scotland; and Carnegie Hero Fund Trust.

—*Science*, 1935, **82**, 365.

Medicine-Man of the Red Indians.*

A MASTERLY treatise on the *Shaman* or the medicine-man of the Red Indians of the New World, written by a well-known professor of the Medical faculty of the Western Reserve University, has recently been published, and this should prove invaluable not only as an authoritative source of reference, but also as a model for future investigations on the medicine-men of the primitive tribes of other parts of the world. The work is further of special value in that it gives a succinct and concise account of the past history of the Red Indians and their influence on the development of the vast continents which have been their home from almost prehistoric times. Their present position is also discussed, and the author remarks that "while four hundred years is not a long time in the history of a race, it is sufficiently long, in a casual study such as I have given him, to obtain a fair conception of his past and to anticipate his destination. His tragic past is closed as the tide of empire westward took its way, and with this ends our theme of the aboriginal in his native state." The future is in the lap of the gods, but reading between the lines there seems little doubt that just as his medicine-man has passed so will the Red Indian in most parts of America under the stress of the modern day conditions to which, in spite of the attempts of the various authorities for his education and civilization, he has not been able to adapt himself; in certain areas he is already "gradually merging with the invading races of the Caucasian and the Negro".

In an introductory chapter the author starts with an attempt at a reconstruction of the family tree of the "American Indian". The name Indian, as the author points out, was a misnomer as applied to the inhabitants of the Americas when Columbus discovered the New World, for they are in no sense allied to the Indian of the Old World. From a careful review of the available evidence he concludes that the American Indian is not the primitive inhabitant of the New World, but migrated to North America some eight to twenty thousand years back across the Behring Strait route from the East Cape, Siberia to Alaska and later "penetrated every portion of the New World from Alaska to Patagonia". All Red Indians, however, did not migrate at the same time nor were they all of a single stock only. After referring to the distribution of the three main divisions of mankind —the Caucasoid, the Mongoloid and the Negroid—the author describes in some detail the racial characteristics of the American Indian, and agrees with the view of most authorities that he belongs to the Mongoloid division of the human race.

Defining Culture as "everything that man does, creates, thinks about and imagines, and hands to the next generation by precept. In short, it is all human behaviour, which is developed and used daily and which is handed down to the next generation by teaching and example," the author asserts that the cultural elements or traits brought with him by the American Indian from the Old World consisted of the "dog, the firedrill, the harpoon, basketry, ideas concerning the causes and cures for disease, family groups and some ceremonial rites." From this meagre inheritance the American Indians developed the highly evolved culture of the Aztecs and the Mayas in Central America and of the Incas of Peru in South America, without any extraneous influences. The two continents of North and South America are divided, on the basis of the different tribes inhabiting the various regions, into fifteen areas of Indian Culture. A short survey of the cultural development in the different areas and their history so far as known is followed by an account of their relationships and racial origin, their religious beliefs, their medicine-men and their conception of disease. After discussing the various tribes and their medicine-men, the author holds forth the view that the most universal and popular theory of the cause of diseases amongst the Red Indians is that of "disease-object intrusion". This is the theory which holds that sickness is due to the presence in the body of some foreign object, such as a fish-bone, a stick, a stone, or a bit of hair. After that, the following causes for illness, given in the descending order of their importance, may be listed: "soul-loss, sorcery, spirit intrusion, and finally, breach of taboo." Every tribe had and has its medicine-men who, before being recognised as such, had to undergo various

* *The Medicine-Man of the American Indian and His Cultural Background.* By W. T. Corlett. (C. C. Thomas, Springfield, Illinois.) Pp. ix + 369, 23 plates, 1935. Price $5 or *Sh.*22/6.

kinds of training, most of which was useless but some had an intrinsic value. The supernatural, of course, played a very important part in the Indian's healing ceremonies, but the medicine-man's job was to inspire confidence and faith on the part of the patient, and as in all medical practice, he used commonsense as the basis of his treatment.

The author includes several references to the surgical skill of the primitive medicine-men or *Shamans* and he quotes from Moodie about the surgical knowledge of the pre-Columbian Peruvians as follows :—" Their surgical attempts are truly amazing and include amputations, excisions, trephining, bandaging, bone transplants (?), cauterization and other less evident procedures." A chapter deals with child-bearing and the various attendant customs and ceremonies as also the part played by the midwife amongst the different tribes. Following such authorities as Morgan and Renaud, the author is of the opinion that " food played an important part in the distribution and culture of the Indian tribes of both South and North America," and he attributes the high stage of evolution of the culture of some of the tribes to their cultivation and use of the Indian *corn*—the maize—just as the " culture of the Orient was founded on rice, and that of Europe on wheat and other cereals". The importance of food in connection with the activities of the medicine-men is considered and the Materia Medica of the different tribes is described in some detail. The fantastic dress of the medicine-man, his medicine-bag, medicine-pipe and the sweat-house are described, and he is considered as " the mediator between his people and the Great Spirit " in trying to cure diseases.

The work is well illustrated and the detailed bibliography and the carefully prepared index greatly add to the usefulness of the work. It is indeed one of the most up-to-date books on the subject, and both the author and publisher are to be congratulated on its production.

B. P.

Science Notes.

Production of Gases during Decomposition of Cane Molasses in the Swamp Soil.—G. Narasimhamurthy, M.Sc., Department of Biochemistry, Indian Institute of Science, Bangalore, writes :—Attention has already been drawn [Bhaskaran *et al.*, *Proc. Ind. Acad. Sci.*, 1934, **1** (**B**), 155] to the fact that a number of gases are formed during decomposition of cane molasses in the swamp soil. In view of the importance of the gases in relation to plant life, a few quantitative studies were carried out, examining the gases produced during two successive seasons, one hot and the other cold. The gases were collected over water and analysed according to the procedure outlined by Kane, Krishnaswami and Watson [*J. Ind. Inst. Sci.*, 1934, **17** (**A**) 33]. The results have been presented in Tables I, II (*a*) and II (*b*) :—

TABLE I.

Rate of Evolution of Gases.

Season : November—December 1934.

Time in Days	1	2	3	4	5	6	7	8	9	10	11	12
Vol. of gas collected in c.c.	Nil	Nil	Nil	98·4	201·1	121·2	69·1	44·8	40·8	27·7	Nil (No further evolution)	Nil

TABLE II (*a*).

Distribution of Gases.

Season : November—December 1934.

Time in Weeks	Percentage of the total volume						
	Carbon dioxide	Oxygen	Unsat. Gases	Carbon monoxide	Hydrogen	Methane	Nitrogen
1	2·0	4·4	Nil	Nil	51·2	4·7	37·7
2	11·0	Nil	Nil	Nil	1·0	12·7	75·3

TABLE II (*b*).

Distribution of Gases.

Season: April—May 1934.

Period in Days	Percentage of the total volume						
	Carbon dioxide	Oxygen	Unsat. Gases	Carbon monoxide	Hydrogen	Methane	Nitrogen
1— 3	13·0	3·9	Nil	Nil	7·5	2·3	73·3
4— 7	11·7	4·5	Nil	Nil	0·6	3·3	79·9
8—10	12·3	7·7	Nil	Nil	0·8	3·3	75·9
11—14	13·8	2·4	Nil	Nil	1·4	5·3	77·1
15—21	4·2	3·2	Nil	Nil	0·5	2·5	89·6
22—28	8·1	3·2	Nil	Nil	Nil	2·9	85·8

There was greater production of gases during the warm months than during the cold ones. The evolution of gases continued over a number of days, even long after the sugars were completely used up. The proportion of the gases was largely determined by the amount of free air space above the fermenting medium: there was increased production of hydrogen and methane with the reduction of air space, while increased air supply led to greater production of CO_2. Under no condition, however, was either carbon monoxide or any of the unsaturated gases produced. The large quantities of nitrogen and small amounts of oxygen present in all the samples were traceable to the air originally present in the soil system.

The author's thanks are due to Dr. K. R. Krishnaswami for much valuable advice and Prof. V. Subrahmanyan for his kind interest in the work.

* * *

The Thermal Structure of the Upper Air over a Depression during the Indian South-West Monsoon. N. K. Sur (*Indian Meteorological Department, Scientific Notes*, Vol. VI, No. 65).—A depression developed in the Bay of Bengal in the first week of September 1932 and passed through Orissa, the Central Provinces and Central India. From sounding balloon ascents at Agra during the week, it is found that temperature at upper levels below the tropopause at first decreased on successive days as the depression increased in intensity and approached Agra. When the depression deepened further and became practically stationary in the neighbourhood of Agra, an exception is noticeable at the levels between 8–12 gkms., where no fall of temperature occurred. At this stage the level of the tropopause above the depression was lowered with an increase of temperature in the lower stratosphere and a decrease at levels immediately below the tropopause. (*Author's Summary.*)

* * *

Inheritance of purple pigmentation in Setaria Italica, *the Italian millet.*—G. N. Rangaswami Ayyangar and his assistants (*The Indian Journal of Agricultural Science*, Vol. V, Part II), summarise their conclusion in regard to the inheritance of this purple pigmentation:—"Plants of the Italian millet are either pigmented (Anthocyanic) or without purple pigment (non-pigmented). The former condition is dominant and arises by the basic presence of a factor P. There are various manifestations and intensities in this pigmentation. A factor I determines a manifestation in intensity. This is dominant to a manifestation in a weaker depth. The degree to which P is operative in addition to being greatly influenced by the presence of I, is conditioned by two other factors V and H, which determine the alacrity with which P manifests in the vegetative or earhead parts. The interaction of P, I, V and H factors produces the diversity of forms characterising varieties of this millet.

Data from over 420 families are presented in support of the above hypothesis. A number of artificial crosses furnish confirmatory evidence."—(*Author's Summary.*)

* * *

Pungency in Chillies.—The inheritance of pungency in chillies (*Capsicum Annum* L.) forms the subject of an interesting study by A. B. Deshpande (*Ind. Jour. Agr. Sci.*, **5**, 4). The results are as summarised below:—"(1) Pungency is definitely a heritable character. The degree of pungency, however, is found to vary considerably with environment such as soil, climate, manurial treatment. (2) The genetic results show that pungency is a simple monogenic character dominant to non-pungency and is determined by a single factor which we have termed C. (3) 'Calyx not enclosing fruit base' has been found to be dominant to 'calyx enclosing fruit base" on a 3 : 1 basis. (4) Both pungency and the nature of calyx, when studied together, have been found to segregate on di-hybrid basis, each quite independently of the other." (*Author's Summary.*)

* * *

Preparation of Beer by the Nagas.—No *Ao* drinks if he can get rice beer (yi C, azu M).[1] Even if a man goes fishing he will take drinks down to the river. At festivals large quantities are drunk, and most people are fairly merry, but no one has ever seen an *Ao* dead drunk or heard of an *Ao* drinking himself to death. On the other hand, many men keep themselves alive for months on rice beer. "Madhu", as rice beer is called in Naga-Assamese, is so sustaining that in the case of old men it often takes the place of solid food. It is made as follows: Yeast (piyazi C; pazai M) is first prepared. To make it, husked rice is soaked in

[1] These remarks do not apply to the Christians who are strictly forbidden by the American Baptist Mission to partake of alcohol in any form.

water in an earthenware pot. The water is drained off and the rice pounded up with likok leaves and spread out on a winnowing fan. This dough is then divided up into four, six or eight elliptical cakes and a similar number of square cakes. The elliptical cakes are called male cakes and the square, female cakes. A layer of rice husks is then spread on a bamboo tray, and over the husks sugar-cane leaves, "to make the yeast sweet". The damp cakes are put on the leaves and after some old yeast has been crumbled over them they are left to dry till the morning of the sixth day, when they are considered ready for use.

To prepare "Madhu" rice is boiled and spread on a mat and allowed to cool. Then pounded yeast and a small quantity of rice husks are mixed with it, the woman who is preparing it saying: "Enter the plantain tree, climb the sugarcane, and be sweet." Immediately after it is mixed it is put into a basket lined with leaves. On the evening of next day it is put into tall baskets lined with plantain leaves and the juice is allowed to drain off at the bottom. This juice is the drink known in Naga-Assamese as "rohi madhu" (mechemzu C; mechem M). It is of about the potency of claret, and is the favourite drink of well-to-do men. To the English palate it is too sticky, and often too sweet to be a "clean" drink, but is very stimulating and by no means to be despised half-way up a long hill. For a thirst quencher the *Ao* prepares "Saka madhu" (tesenzukyi C; azu techenlak M), a drink resembling very thin gruel, and less potent than the lightest beer. To prepare it fermented rice from which the "rohi madhu" has drained is put into a sieve (sanku C; changku M), and hot or cold water is poured on to it. The milky fluid which results is the ordinary household drink of an *Ao* family.

* * *

Archæological Trial Excavations at Patna—Discovery of Ancient Wooden Foundations.—On receipt of a report from the Chaukidar at Kumrahar (near Patna) that traces of some wooden structure have been exposed in a brick-field, the Archæological Superintendent of the Central Circle, Patna, proceeded to examine the nature and extent of the ancient remains by trial diggings. The result was the discovery of a long wooden platform, about 100 feet in length and 5′–6″ in width, and 7′ in height running north and south. The bottom of this structure is 22 feet below the level of the road nearby and seems to continue at either end. Wooden structures were unearthed previously at the Bulandibagh and Kumrahar excavations by the Archæological Department, and another has recently been brought to light by the Public Health Department in course of laying sewage pipes to the east side of Kankarbagh Road. The minor antiquities found at Gonsai Khanda consisting mainly of small pottery cups, potsherds and terracotta balls, etc. are similar to those discovered at Kumrahar and Bulandibagh and may be attributed to the Mauryan epoch. A small walling of Mauryan bricks was also found at right angles to the wooden structure near the top. The particular purpose for which all these wooden structures at the ancient site of Pataliputra were constructed is not determined. The Bulandibagh pieces might well have formed part of the old wooden palisade of Pataliputra but the Gosai Khanda construction is more likely to be a coffer dam erected in connection with training and revetment of a river bank or the construction of a wharf. The favourable situation of ancient Pataliputra at the confluence of the Son and the Ganges, made it a great centre of inland water-borne traffic, and there must have been a river port of considerable importance at Pataliputra, and wharfs and docks must have been found necessary, where such coffer dams of which the remnants have been laid bare were sometimes constructed.

* * *

Some Early Indian Paintings Discovered by Prof. Joureau-Dubreuil in Tinnevelly District.—At a recent meeting of the Archæological Society of South India, Messrs. T. N. Ramachandran and C. Sivaramamurti, exhibited copies of some early paintings discovered on the ceiling of the mandapa and on the pilasters of a cave temple in Tinnevelly District. The temple bears an inscription of the 12th–13th century A.D. relating to the Pandyan King Srivallabha. The paintings appear to be of Pandyan art, and no paintings representing this were previously known. The paintings are relatively rich in *rekha* or line and lacking in *bhushana* or ornament.

Mr. Paramasivan gave an account of the technique of the process of painting used. The pigment consists of a mixture of yellow particles (yellow ochre) and much-faded blue particles (indigo). The binding medium appears to have been starch paste but this is very far from certain.

* * *

The Patwar Meteorite.—At the ordinary monthly meeting of the Asiatic Society of Bengal held on 4th November 1935, Dr. A. L. Coulson presented an interesting account of the meteoric shower which occurred at about 11.20 hours on the 29th July 1935, near the village of Patwar (23° 9′: 91° 11′), Bhatupara, Gotrasal, Fatehpur and Majhipara near Nangalkot, some 20 miles due south of Comilla, the chief town of Tippera district. Two months ago Dr. Coulson read a paper on the Perpeti meteoric showers (see *Curr. Sci.*, 1935, **4**, 120). "Patwar is only some 17 miles south-east of Perpeti, also in the Tippera district. The two falls, however, are distinct but it would be interesting to learn of any other occurrence of two separate meteoric showers within 17 miles of each other after a lapse of two and a half months.

"So far three specimens, totalling 35,013.5 grams, which fell at the three first-named villages have been recovered, the largest (23,111.6 grams) falling at Patwar which gives its name to the fall. However, two small additional stones from the villages of Fatehpur and Majhipara have been recovered and sent to the District Magistrate, Comilla.

"The fall was accompanied by the usual phenomena of light and sound. A dazzling light following a "loud rumbling noise" is supposed to have been the first indication to the villagers of the fall of the meteorite. The sound is stated to have been so loud and continued, that those in the police thana at Chauddagram, some 7 miles to the north-east of Fatehpur, the nearest locality to the thana from where stones were recovered, distinctly heard it. Four reports "like thunder" were heard in quick succession. One observer adds that a peculiar sound like "that of an

aeroplane" followed the reports; this may have reference to the passage through the atmosphere of the disrupted members of the parent meteorite.

"The largest specimen penetrated to the ground to a depth of 34 inches.

"The parent meteorite appears to have been moving in a west-south-westerly direction. The smallest pieces fell first, followed in succession by the larger. The total rectangular area covered by the shower is roughly about 4½ square miles, the length being some three miles in the direction E.S.E.-W.S.W.

"The meteorite has great interest on account of its rather rare composition. It belongs to the group of mesosiderites, being a siderolite intermediate in composition between a stone and an iron. It contains large crystals of olivine and masses of nickel-iron of fair size. It is composed chiefly of nickel-iron with olivine, enstatite and bytownite, with smaller amounts of schreibersite, troilite, oldhamite, lawrencite and hydrocarbons. Its specific gravity is 4.21."

* * *

The Doon School.—India's First Public School, the Doon School, run entirely on lines on which Schools in England are conducted, was opened by H. E. the Viceroy on the 27th October. There are in India institutions on a residential basis, but they invite particular class of students, *e.g.*, chiefs' sons, or are intended to prepare for a particular career in later life, *e.g.*, army. The School, which is the first of its kind in the country, and at present considered to be of the nature of an education experiment, owes its inception to the late Mr. S. R. Das, who was the originator and founder of this great venture. It is run entirely on British lines and the Principal, Mr. A. E. Foot, is one who has considerable experience of Public Schools in England. The main purpose of the institution will be to provide education to young men and women, which will enable them to become useful citizens of the country. This education will help in the formation of character, "which will develop our citizens with a high sense of honour, of responsibility and of discipline, qualities which are absolutely essential to all services in public life." There are boys in the School from all Provinces and many Indian States. All religions are respected. The School is open to Indians of all castes and creeds and will be run as an individual unit with a purpose, a function and aim all its own.

The School, at present, has a strength of 70, which will be raised to 180 by next February and the School will ultimately provide education for 400 boys. The Doon School is located in an estate known as 'Chand Bagh' in Dehra Dun. Negotiations are in hand to acquire an adjacent estate known as Skinnes' estate, which will provide for further extension.

* * *

Asiatic Society of Bengal.—Dr. Sunder Lal Hora of the Zoological Survey of India gave a paper on "Recent Indian Cases of Live Fishes Impacted in the Food and Air Passages of Man" at the Medical Section of the Asiatic Society of Bengal on the 18th instant. Lt.-Col. B. G. Mallya dealt with the surgical aspect of such cases. It is understood that the paper, which is bound to be of great medical interest, will be published shortly.

It was understood that Dr. Hora would have been able to exhibit a specimen of a small fish impacted in the pharynx of man, preserved in the Pathology Museum of the Medical College, Calcutta, but unfortunately, the specimen had crumbled into pieces and was not available for exhibition.

* * *

The Industries Conference.—The Seventh Industries Conference was held at New Delhi, on the 28th and 29th October, and was opened by Sir Frank Noyce, Member for Industries and Labour. The Conference has concentrated its attention on the development of the Handloom Industry and at the last Conference held in July 1934, a sum of Rs. 5,70,000 was allotted to Provincial Governments for expenditure on approved schemes during the 17 months from November 1934 to March 1936. The schemes are of varied character, including the training of weavers in improved methods of production, establishment of sales depots and weavers' co-operative societies for marketing handloom products and introduction of new patterns, new designs and improved appliances. The Conference reviewed the progress achieved in the working of the various schemes. The schemes were initiated only recently, and much could not have been achieved. The prospects of success are however indicated; and it is expected that for the next year more grants would be made available. The Conference has agreed to hold an exhibition of handloom machinery and fabrics in February 1936, (9th-24th) at Patna and will organise a competition for handloom weavers. The Conference also discussed questions relating to the abolishing of restriction in respect to fees charged in technical institutions from students belonging to the Province and those coming from other provinces. Another important subject discussed was the regulation of labour (particularly child labour) in unregulated factories and workshops.

* * *

The Imperial Sericultural Committee, which was established in accordance with the recommendations of the Tariff Board, held its second meeting on the 31st of October. It may be recalled that at the first meeting held on February 25th, grants amounting to Rs. 93,000 were allotted to various provinces for working out schemes, connected mainly with the increase of the production of disease-free seed and the investigation of silk-worm diseases. The Committee reviewed the work and decided to recommend further allotments from the Sericulture Fund for 1936–37. The proposals for the improvement and development of the Sarrar Silk Industry in Bihar and Orissa and for the expansion of the sericultural farm in Shillong, were considered and approved.

* * *

The Institute of Engineers, India, has been granted the Royal Charter. This is the first instance of the Charter being granted to a professional body, which has its origin and function solely in India. The Institute was formally constituted as a corporate body with Sir Thomas Ward as the first President on September 13, 1920, and was inaugurated by Lord Chelmsford on February 23, 1921.

* * *

Education and Vocational Training.—In the course of his inaugural sessional address at the

opening of the ninety-fourth Session of the College of the Pharmaceutical Society, on October 2, Sir Frederick Gowland Hopkins discussed, among other topics, the one on "how far vocational training is compatible with true education in which a subject is studied for its own sake as an intellectual exercise." It has often been said that science can only be taught properly when it is taught as pure science without reference to its applications. This claim is justified to the extent that vocational needs must not make the teaching of science so one-sided that the student risks missing the intellectual stimulus which the great generalisations of science provide.

"Teachers of applied scientific subjects will be grateful to the president of the Royal Society for his declarations that the skilful teacher of students whose ultimate aim is to apply science in practice, can illustrate general principles adequately while selecting facts and aspects which have a permanent vocational value. Indeed, for the encouragement of the average student, it is important that the reality of this permanent value should be part of his faith. Without it he can never be an enthusiast for his calling. The preference for vocational training may well be based on the Anglo-Saxon preference for action rather than thought and for practice rather than theory, but it is an attitude of mind having in it the seeds of certain dangers. Indeed, a distrust of theory has sometimes kept Great Britain from being in the van of intellectual and not less of commercial progress."—(*Nature*, Oct. 12, p. 614.)

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Counting by Eights.—In an interesting article published in the *School Science and Mathematics* (April 1934), E. M. Tingley, 221, North Cuyler Avenue, Oak Park, Illinois, U.S.A., has made a vigorous plea for calculating by *eights*, not by *tens*. Humanity has been adopting the metric system for over eight centuries. Mr. Tingley considers that the base eight is more natural. We have two eyes and two hands; we prefer to double or halve things. "Halves of things are much easier to comprehend than thirds or fifths, because halves are simpler and fewer. Therefore we should also use measures and an arithmetic base containing only even factors to treat the preferred even divisions. Eight gives the best even scale or base for this arithmetic." The decimal counting and calculating scale contains the odd fives, and it is said, calculation based on fifths and thirds is troublesome.

The question is a very serious one, and to discard a system which has been in vogue ever since the present method of writing numbers was devised (750 A.D.) in preference to a new system, it is necessary to have convincing psychological proof. The psychologists should measure our preferences towards the two systems and declare which of them is more natural and simpler to comprehend.

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Synthetic Rubber.—A proclamation has recently been issued by Herr Hitler to the effect, that "as the problem of producing synthetic rubber can now be regarded as definitely solved, the erection of the first factory in Germany for this purpose, will at once be begun." Thus to the already large list of synthetic productions of natural raw materials, one more has been added. Rubber is one of the cheapest and most plentiful of raw materials, and attempts are not wanting for cheapening it further by systematic work on the plantations and in the factory. The German chemists at the Interssen Gemeinschaft have now succeeded in supplanting rubber by an artificial product and further developments are awaited.

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Real Silk Industry.—So much is being written and spoken about the artificial silk industry, that an impression is gaining ground that the real silk industry is doomed to extinction. An article appearing in a recent number of *Chemical Age* (Oct. 12th, 1935) by A. T. Hall, on real silk, however, serves to give a scientific picture of the real position.

For many purposes, pure silk cannot be replaced by rayon and indeed in some lines, "pure silk is ousting rayon." Thus in the hose industry, pure silk is becoming increasingly popular, Rayon becomes much dearer in the form of fine yarns, while the price of fine pure silk yarns is not much different from that of coarser yarns.

In the actual processing, the degumming of silk has attracted considerable attention at the hands of the research chemist. Sericin is the gum which cements together the raw silk threads which when taken from the cocoon are harsh, lustreless and coloured, while possessing strength. Sericin can be removed by aqueous solutions of alkalies and in recent years, sodium silicate is being used extensively together with soluble sulphonated oils. Degumming gives soft, lustrous silk, which is almost colourless. There are actually three sericins, distinguished as sericin A, sericin B and sericin C. Sericin B is a very valuable compound as it possesses excellent dispersive and penetrating properties which become effective when degumming liquor is used to assist in the dyeing of silk yarns.

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Coal Hydrogenation Petrol Plant.—The opening of the petrol plant by Mr. Ramsay MacDonald on the 15th October at the Billingham Works of the Imperial Chemical Industries, Ltd, has brought to a practical commencement an enterprise which marks a revolution in fuel technology. The plant is the first in the world for the hydrogenation of bituminous coal. The process, due to Prof. F. K. R. Bergius, consists essentially in hydrogenating raw coal cleansed to less than 2½ per cent. of ash and ground up to a paste with oil to give a 50 per cent. coal-in-oil paste. This is injected into converters against the working pressure of 250 atm. and mixed with hydrogen. The mixture is heated up to 450° C. and the hydrogenation takes place at a temperature of 450° C. and 250 atm. pressure. A small heavy oil fraction containing the unconverted coal (about 5 per cent. by weight) and ash separates and is treated for oil recovery, the coke residue being used as a fuel. The major part of the coal is transformed into lighter oils which are separated and distilled into heavy oil, middle oil and petrol. Heavy oil is further hydrogenated to give middle oil and petrol. The middle oil is hydrogenated again in vapour phase converters, in which the vaporized light oil and hydrogen are passed over a solid catalyst. The crude vapour phase product is distilled, the residual middle oil being separated from petrol and treated again. The whole

of the coal is thus transformed into small consumable solid residue, gas and petrol.

The hydrogenation of coal is a self-contained process as the only raw materials used are coal and water, and if desired petrol can be the sole end product. Conditions can, however, be arranged to give fuel oil, diesel oil, petrol and liquefiable hydrocarbon gases such as propane and butane. The company started work on hydrogenation in 1927, and since that date has spent over a million pounds over research on that one subject, and in 1930–31, a small plant was installed for treating 15 tons of coal per day. The present output is 400 tons of petrol per day representing a total annual output of 45,000,000 gallons, forming only 4 per cent. of the country's consumption of petrol. The production, for a long time to come, may be in the nature of a supplement rather than a principal source, but still from this and other plants that might be erected in due course, there is reasonable chance of this supplement increasing in quantity. 4 tons of coal are required to produce about a ton of petrol.

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Arctic Exploration.—An extra strong wooden ship whose ultimate duty will be to become frozen in Arctic ice and drop into ice fields with high latitudes will be completed early in 1937. Professor Wiese, the Soviet explorer, has announced, that in general, the design of the ship will form that of *Fram* used for similar duty by the Nansen expedition to the Arctic in 1893–96. The chief object of the expedition which will use the new ship will be a thorough study of the deep parts of the Arctic basin which are covered the year round with ice crust so thick that the strongest ice breakers cannot pierce it.—(*Science*, 1935, **82**, No. 2127, Suppl., pp. 14.)

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British Industries Fair, 1936.—The next British Industries Fair will be held in London from February 17th to February 28th, 1936. Information regarding the Fair can be obtained from the High Commissioner for India, India House, Aldwych, London, W.C. 2.

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Chemical Research in China.—"The rapid growth in the amount of chemical research, both pure and applied, in China during the last decade, is phenomenal. Research institutes are springing up everywhere, and a genuine effort is being made to give experience in research as an integral part of the training of every University Science graduate. Attention is being continually devoted towards the scientific study of the old chemical industries which flourished in ancient China. The British Boxer Indemnity Fund, for example, is supporting research at Yenching University aiming to improve the pottery industry of Peng-Cheng, Shansi. At Nankai University and the Golden Sea Research Institute, projects of a similar nature are being undertaken. Specialists on rural economics are stressing for China, improvement and further development in the village industries.—(*Ind. Eng. Chem., News Edition*, 1935, **13**, 358.)

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Consequent to the retirement of Diwan Bahadur Sir T. Vijayaraghavacharya, the following officiating arrangements have been made from 26th October 1935 :—

Mr. B. C. Burt, Vice-Chairman of the Imperial Council of Agricultural Research.

Dr. F. J. F. Shaw, Agricultural Expert to the Imperial Council of Agricultural Research.

Rao Bahadur B. Viswa Nath, Director, Imperial Agricultural Institute, Pusa, in addition to his duties as Imperial Agricultural Chemist.

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Dr. S. K. Mitra, Professor of Physics, University College of Science, Calcutta, has proceeded to Europe on a Travelling Fellowship under the Calcutta University, for the purpose of studying the recent developments in wireless and television.

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Dr. S. N. Chakravarthy, and Messrs. K. S. Venkataramani and Ramaswamy Sivan have been declared elected by the Senate to the Syndicate of the Annamalai University.

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It is understood that the Senate of McGill University of Canada has sent felicitations to its oldest graduate—Dr. Griffith Evans of Bangor (Wales), who recently celebrated his 100th birthday. Dr. Evans took his M.D. Degree at McGill in 1864.

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Noble Laureateship for 1935.—Chemistry: Professor Joliot and Madame Curie-Joliot. Physics: Professor James Chadwick. Physiology and Medicine: Professor Hans Spemann.

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Cornell University.—A gift has recently been made to the University by Dr. L. H. Bailey, Professor Emeritus of Agriculture and Mrs. Bailey of one of the most extensive herbariums in this country. This collection comprises over 125,000 mounted herbarium sheets, especially rich in cultivated material, and there are also included in the gift 4,000 technical books related to horticulture and botany, thousands of photographs, working equipment, etc., the buildings which house the collection, and about 0.25 acre of land. In accepting the gift the University nas authorized the establishment of an administrative unit in the College of Agriculture to be known as the Liberty Hyde Bailey Hortorium. This will be under the direct supervision of a staff member and with a full-time curator and an advisory board consisting of the supervisor, the curator, representatives of the major fields of plant science, and two members at large. One or more graduate fellowships to be known as the Liberty Hyde Bailey Botanical Fellowships will also be established.—(*Experiment Station Record*, Vol. 73, No. 2.)

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Bibliography of Soil Science, Fertilizers and General Agronomy, 1931–34.—The Imperial Bureau of Soil Science has recently published this bibliography consisting of over 6,000 references to papers, bulletins and reports published throughout the world in the years 1931–34, and dealing with pure and applied soil science. The volume contains (1) an index to the decimal classification, (2) an alphabetical cross index to every subject on which the papers listed have been written, (3) an author index containing over 4,000 names, and (4) a list of abbreviations used, and the full titles and places of issue (where known) of 800 journals, etc., from which the references in the bibliography have been taken. The bibliography containing 504 pages, is bound

in cloth, and is priced 25s. net, and can be obtained post free, from the Imperial Bureau of Soil Science, Harpenden, Herts, England.

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The Indian Physico-Mathematical Journal, September 1935.—*The number of representations of a large number as a Sum of* n *non-negative* nth *powers :* By S. Chowla. The following theorem is proved: For a fixed value of n, $r_n, n\ (N) \neq O(1)$ *i.e.*, for an arbitrary value of A, we can find infinitely many values of N such that $r_n, n\ (N) > A$. The symbol $r_s, n\ (N)$ denotes the number of representations of N as a sum of s nth powers $\geqslant 0$.

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The Mathematics Student, June 1935.—(1) *On G-Functions in General :*—By Hans Raj Gupta. In previous papers, Mr. Gupta has studied some properties of $G\ (n, r)$ where

$$(x+1)\ (x+2)\ldots(x+n) = \sum_{0}^{n} G\ (n, r)\ x^{n-r}$$

In the present paper, the author attempts a general definition for the function $G\ (x, \rho)$ for all values of x, ρ being a positive integer $\geqslant 1$ and mentions that his results have been useful in a paper of his on "Ward's Numbers" under publication.

(2) *Focal lines of a Cone touching four given concurrent planes :* By A. A. Krishnaswami Ayyangar.

If the planes are parallel to the faces of a tetrahedron, the author proves that the focal lines are parallel to the axes of circular cylinders circumscribing the tetrahedron.

The theorem is the outcome of Mr. V. Ramaswamy Aiyar's paper on "Circular cylinders circumscribing a tetrahedron" in *Math. Student*, Vol. II, No. 3.

A few corollaries are added.

C. N. S.

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Messrs. Chapman and Hall.—We have been informed that Messrs. Chapman and Hall, the well-known publishers of General Scientific and Technical books, have been appointed sole agents for the British Empire, for the CHEMICAL CATALOG Co., of New York, from 1st November 1934. This news will be welcomed by all, particularly chemists, in all parts of India, as they are thereby enabled to obtain the Volumes direct from Messrs. Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C. 2.

A full list of the books of the Chemical Catalogue Company have been prepared and can be obtained from Messrs. Chapman & Hall, Ltd., London.

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Recent Publications.—Edward Arnold & Co., London :—

Forensic Chemistry, and Scientific Criminal Investigation, by A. Lucas, O.B.E., F.I.C.

The Structure of the Alps, by Leon W. Collet, D.Sc.

The Oyster, and the Oyster Fishery, by J. H. Orton.

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The Indian Lac Cess Committee.—The attention of our readers is drawn to an advertisement appearing in this issue of the Journal, inviting applications for the post of Director, Indian Lac Research Institute, Namkum, Ranchi — Salary Rs. 1,250–50–1,500. Last day for application—14th December 1935.

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Announcements.

Krusadai Biological Station.—The following scale of fees will be levied from post-graduates and under-graduate student parties from Colleges and Universities for services rendered by the Krusadai Biological Station in connection with the collection and study of marine fauna and flora :—

1. Post-graduate workers such as M.A. and M.Sc. students, and Professors doing research.	Rupee one per day for the first three days and annas eight per day for the subsequent days of halt.
2. Under-graduates who come for collection of specimens.	Annas eight per day for the first three days and annas four per day for the subsequent days of halt.
3. The Professors who accompany the under-graduates that do not do research of their own.	Do.

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Discussions at the Indore Meeting of the Indian Science Congress.—The following discussions, which will be held during the meeting of the Indian Science Congress at Indore in January next, are announced in advance in order to enable those who may wish to take part to have an opportunity of preparing their remarks. The following joint discussions have been arranged :—

Agriculture and *Medical Sections*, "The Making of Humus and its Application";

Chemistry and *Physics Sections*, "The Structure of Molecules";

Medical and *Physiology Sections*, "The Problem of Nutrition in India"; and

Botany and *Zoology Sections*, "The Teaching of Biology in Secondary Schools".

The following discussions, confined to single sections, have also been arranged :—

Chemistry Section, "The Scope of Preparation of Fine Chemicals in India", and "The Utilisation of Molasses";

Geology and *Geography Section*, "The Classification of the Archæan Rocks of India";

Botany Section, "The Myxophyceæ", "Saltation in Artificial Cultures of Fungi", "The Standardisation of the Vernacular Names of Indian Plants", "Chromosome Morphology and Polyploidy", and "The Importance of Anatomy and Taxonomy".

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We acknowledge with thanks the receipt of the following :—

"The Agricultural Gazette of New South Wales," Vol. XLVI, Pt. 10, Oct. 1935.

"Transactions of the Faraday Society," Vol. XXXI, Pt. 10, Oct. 1935.

"Journal of Agricultural Research," Vol. 51, No. 2.

"Journal of Agriculture and Livestock in India," Vol. V, Pt. V, Sept. 1935.

"The Journal of the Royal Society of Arts," Vol. LXXXIII, Nos. 4323-4326.

"Indian Journal of Agricultural Science," Vol. 5, Pt. IV, August 1935.

"Biochemical Journal," Vol. 29, No. 9, Sept. 1835.
"American Journal of Botany," Vol. 22, No. 8, Oct. 1935.
"The Journal of Institute of Brewing," Vol. XLI, (New Series, Vol. XXXII), No. 10, Oct. 1935.
"Canadian Journal of Research," Vol. 13, No. 3, Sections A and C.
"Chemical Age," Vol. 33, Nos. 848–851.
"Berichte der Deutschen Chemischen Gesellschaft," Vol. 68, No. 10.
"Experimental Station Record," Vol. 13, No. 3, Sept. 1935.
"Indian Forester," Vol. LXI, No. 11, Nov. 1935.
"Forschungen und Fortschritte," Vol. 11, Nos. 28–30.
"Bulletin of the Geological Institution of the University of Upsala," Vol. 22, 1930; Vol. 23, 1932.
"The Quarterly Journal of the Geological, Mining and Metallurgical Society of India," Vol. 7, No. 2, June 1935.
"Indian Physio-Mathematical Journal," Vol. 6, No. 2, Sept. 1935.
"The Review of Applied Mycology," Vol. 11, Pt. 1, Jan. 1935. (Issued by the Imperial Mycological Institute.)
"Nederlandsch Tijdschrift Voor Natuurkunde," Tweede Jaargang, Nummer 7.
"Mathematics Student," Vol. III, No. 2, June 1935.
"Medico-Surgical Suggestions," Vol. 4, No. 9, Sept. 1935.
"Indian Meteorological Department Scientific Notes." Vol. VI, No. 65. "The Thermal Structure of the Upper Air over a Depression during the Indian South-West Monsoon." By N. K. Sur.
"Nature," Vol. 136, Nos. 3439–3442.
"Journal of the American Museum of Natural History," Vol. 36, No. 3, Oct. 1935.
"The Journal of Nutrition," Vol. 10, No. 3.
"Acta Phytogeographica Succica":—
II. Der See Fiolen und Seine Vegetation, von Sven Thunmark.
III. 1. Life-forms of Terrestrial Flowering Plants I. By G. Einar Du Rietz.
IV. Om Den Vildväxande Skogsalmens Raser Och Deras Utbrednüng I Nordvästeuropa, av Bertil Lindquist.
V. Vegetation of the Pacific Coast Bogs of North America. By Hugo Osvald.
"The Journal of Chemical Physics," Vol. 3, No. 10, Oct. 1935.
"Indian Journal of Physics," Vol. 9, Pt. VI, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 18, Pt. VI, Sept. 1935.
"Science Progress," Vol. 30, No. 118, Oct. 1935.
"Science and Culture," Vol. I, No. 6, Nov. 1935.
"United States Department of Commerce: Journal of Research of the National Bureau of Standards," Vol. 15, Nos. 1 and 2, July and August 1935.
"The Indian Trade Journal," Vol. CXIX-Nos. 1529–1533.

CATALOGUES.

"Hilger Catalogue G. Astronomical Spectrographs and Spectroscopes," (Messrs. Adam Hilger Ltd., London.)

"Some Mathematicians I Have Met."*

[Prof. Born prefaced his remarks by saying that he was not a professional mathematician and was grateful for being asked to talk not a mathematical problem, but on a general subject. He proceeded to classify the many mathematicians he had met as falling under the three generations of teachers, colleagues or friends, and pupils.]

RECALLING his early days at Breslau where he attended courses of lectures on Philosophy, Chemistry, Physics, Astronomy, Economics and Law, he mentioned the profound impression created by his astronomical studies and by the old Observatory of his College, the instruments going back to the times of Wallenstein and his astrologers, the most modern being a meridian instrument of Bessel (about 1800). In Mathematics his teachers were Rosanes from whom was acquired the first clear idea of mathematical infinity and the technique of matrix calculus which stood in such good stead, later on, for the development of quantum mechanics; and London, the father of F. London who is now well known to physicists by his work in collaboration with Heitler on the theory of valency.

And then at Heidelberg with Kœnigsberger, the biographer of Jacobi and Helmholtz. Kœnigsberger was an Anti-Kant and an Empiricist who even maintained that the formula $(a+b)^2 = a^2+2ab+b^2$ could be derived only from experience! The methods of differential geometry were acquired here and it was mentioned how these good old methods came in handy quite recently for the new field theory, when Weierstrass' results on minimal surfaces were suggested to Pryce in connection with his work on the two dimensional electrostatic case.

It was next at Zurich that he met for the first time a brilliant modern mathematician Hurwitz, a friend of Minkowski and Hilbert. Hurwitz, so well known by the "Hurwitz-Courant" of the yellow series of volumes, was a most inspiring lecturer too.

And at last Göttingen! Of whom else at Göttingen should he talk first if not of Hilbert who is, by common consent, the doyen of present-day mathematicians? Prof. Born spoke at length about his distinguished teacher, of his stimulating lectures, his mathematical work, his influence on his students and his personality. He recalled a hiking excursion to an old ruined town Plesse with Minkowski, Hilbert and Caratheodory during which he mustered sufficient courage to approach Hilbert and ask him why he studied Mathematics. The answer, so characteristic of Hilbert, was that he had chosen this subject because he had a bad memory! Hilbert's lectures in the class-room left the greatest impression

* Summary of a lecture delivered by Prof. Dr. Max Born before the Central College Mathematical Society, Bangalore, October 1935.

on his hearers and had the quality of everlasting stimulation. He would set out to devise in the class-room new and better proofs of theorems, invent new theorems and if unsuccessful return the next day with beautiful results which have been the admiration of the mathematical world. His mathematical activity could be classified into six periods: (1) Numbers, (2) Invariants, (3) Axioms of Geometry, (4) Integral Equations, (5) General Relativity and (6) Mathematical Logic. Hilbert laid the greatest stress on rigour and logical foundations and on the meaning of pure thinking independent of content. He was perhaps not endowed with the gift of physical insight commensurate with his genius in mathematics and he never felt quite happy in his relations with physicists as evidenced by his quarrel with Pringsheim. Talking about his personality Prof. Born called it strange and likened it to a crystal with sharp edges. People did not understand him. His thinking never went the smooth path of everybody's opinion, but was absolutely independent and unconventional. He had a sharp tongue and was not always what one would call a nice fellow, but he was faithful and good to his friends. He took great interest in politics where, as in everything else, he went his own way and liked to shock people by his opinions, which were always well founded. Even when he changed from extreme pacifism in which he believed during the war into a conservative attitude during the socialistic revolution, he had good reasons for doing so.

Talking next about Klein, the contrast between Hilbert and Klein was pointed out. Klein disliked in his lectures rigorous methods and preferred to give the constructive ideas of mathematics. Having undergone a breakdown in health on account of overwork in trying to keep ahead of Poincaré, he assumed the rôle of an educationist and took great interest in presiding over mathematical societies and in reforming methods of mathematical teaching. A very amusing incident was narrated of how Klein went on discussing, at one of the meetings of the Mathematical Society a Dutch book on "Flacke Krommen" and talked at length about the theory of surfaces until at last it was pointed by one of the audience that "Flacke Krommen" did not mean "Krumme Flächen" but "Ebene Kurven"!

Then came Minkowski who was attached to Hilbert in the most intimate friendship. Minkowski delivered brilliant lectures on Geometry and other topics. His actual original contributions to relativity have perhaps not been so far appreciated properly. It was during the seminars on electrodynamics conducted by Hilbert and Minkowski that the latter was developing his four-dimensional world theory when Einstein's paper appeared and it can be safely said that Minkowski's work was done quite independently. Prof. Born mentioned that his own first paper in Breslau was on relativity, *viz.*, on hyperbolic motion which caught Minkowski's notice who asked the author of the paper to be a lecturer at Göttingen.

Last but not least among the giants of Göttingen was the brilliant Carl Runge, the applied mathematician and spectroscopist, who it was that introduced Prof. Born into modern physics. An important feature of the mathematical life at Göttingen of those days was the Thursday afternoon walk of Klein, Hilbert, Minkowski and Runge. A separation of this company was effected by the sudden death of Minkowski from appendicitis and on this occasion Hilbert delivered his famous memorial speech on Minkowski. In this connection it is interesting to know that in Hilbert's estimation Cantor, Minkowski and Hadamard, three Jews, were among the first order mathematicians.

Minkowski's successor in Göttingen was Landau, well known for his brilliant work on the analytical theory of numbers and many other subjects.

Passing on next to his friends and colleagues, Prof. Born mentioned in the former category the names of E. Schmidt (Berlin) known for his work on integral equations and potential theory, Caratheodory of real variables and variations, Zermelo of Mengenlehre, Herglotz, Max Abraham and others. When talking of Kœbe, an incident that happened at Rome when the International Mathematics Congress met there, was narrated of how when looking at the celebrated paintings of Michael Angelo in the Sixtina Chapel, Kœbe burst out on the ephemeral nature of works of art of this type as contrasted with his uniformisation theorems which would stand for all time! This was how he acquired his nickname of "Kunstmäcen." The other lecturers at Göttingen were Hermann Weyl famous for his group theory, Hecke, Tœplitz, Courant and Emmy Nœther, who has died recently in America. At her funeral Weyl said in his commemoration speech, that she is considered as the greatest woman mathematician known in the history of science, greater even than the famous Sonja Kowalewski.

The associations with Planck and Einstein at Berlin in war time were next touched upon. It was unfortunate that Einstein should have got mixed up in politics with his strong tendencies towards pacifism, liberal doctrines and socialism. This led to the unfortunate conflict with Lenard and Stark. Einstein's scientific work could be divided into two periods—the physical and the later mathematical period of which the first seems to be far more fruitful.

Talking in general terms, Prof. Born said that as a rule the physicists he had met were more "normal" and therefore less interesting than the mathematicians. An exception, however, was the case of Ehrenfest who was a strange character. He was a true cosmopolitan, born in Vienna, educated partly in Germany, thoroughly acclimatised in Russia, and at last Professor at Leiden in Holland. He was a man of intense feeling with a great capacity for pure and clear thinking. His house was bare without any furniture and a wall of it served as visitor's book whereon could be found the names of all great men who visited him! Freedom from tradition was a passion with him. He got his meals from public kitchens and never sent his children to school for their education. His Russian wife and his eldest daughter both were called Tatjana, but for distinguishing between them his friends used to style them (Tatjana) and (Tatjana)'! He died under tragic circumstances having committed suicide by shooting himself with a revolver; this fatal step was the result of a deep depression which overcame him very often when he found difficulties to keep step with the progress of the younger generation of theoretical physicists.

A rapid survey was then made of the foreign mathematicians and theoretical physicists whom he had met. In referring to Niels and Harald Bohr, he spoke of the former's great gift of physical intuition and likened him to a magician who, though not much of a mathematician, could grasp the physical aspect of a problem immediately. Amongst the Dutch scientists the palm was given to Lorentz, a great leader of scientific activity and the President of the Solvay Congress. Lorentz's lectures at Göttingen were then recalled. Reference was also made to Kramers, Ornstein and Brouwer. Brief mention was made of Poincaré, Hadamard, de Broglie and Brillouin in France, of Levi-Civita and Fermi in Italy, of Frenkel, Alexandrow and Fock in Russia, and of Moore, Birkhoff, Veblen, Wiener, Alexander, van Vleck (senior and junior) in America. Amongst the English mathematicians and physicists he had met, Prof. Born talked about Hardy, Littlewood, Darwin, Fowler and Dirac. About the silent Dirac, Professor at Cambridge, mention was made of the 'unit' invented by his friends, *viz.*, 1 Dirac = 1 word per hour!

In the last category of his pupils, Prof. Born spoke about Pauli, Heisenberg, Jordan, Hund, Dirac, Fermi and v. Neumann whose book on quantum mechanics was considered to go deepest into the subject. B. S. M.

What are Cosmic Rays?

IT is well known that X-Rays and the radiations emanating from the radioactive substances ionise air so that it becomes a conductor for the flow of electricity. It was found at the end of the nineteenth century that air possesses a residual ionisation (after all the contributions to ionisation from radioactive sources were taken into consideration or suppressed). This result did not seem surprising at first as the residual ionisation was attributed to the defects of the instruments or to the presence of minute quantities of radioactive substances, too minute to be detected. It was subsequently found that the phenomenon of the residual ionisation disappeared in deep mines, had an altitude effect and possessed many other peculiarities. Hess, Kolhorster, Bergwitz and Gockel found that the phenomenon depended on the altitude. Balloons provided with automatic arrangements for recording ionisation were used in the earlier experiments. In a recent flight, Piccard flew to a height of 16 kilometers and recorded an ionisation as great as 200 ions per c.c. per second in the upper atmosphere. These facts support the view that the residual ionisation is genuine.

The radiations emanating from radioactive substances responsible for the ionisation of the air are α-rays consisting of α-particles whose penetrating power is small, β-rays consisting of very high velocity electrons of a moderate penetrating power and γ-rays which are electromagnetic in nature with a very high frequency. It is natural to think that the primary radiation responsible for the residual ionisation of the atmosphere is due to some extreme form of either β-rays or γ-rays. There is one school of thought, led by Professor A. H. Compton, who interpret the residual ionisation as due to very high velocity electrons like those of the extreme form of β-rays, pouring like a rain on the earth from the outer space. There is another school of thought led by Professor R. A. Millikan, who hold the opinion that the primary radiation responsible for the residual ionisation is electromagnetic in nature like the extreme form of high frequency γ-rays. Apart from the divergence of the opinions held by the physicists, the phenomenon of the residual ionisation seems to be certainly connected with some processes occurring in the outer space or with causes not at all understood in Modern Physics. The radiations responsible for the residual ionisation of the atmosphere have been called the cosmic rays. It is important to realise that for observing the phenomenon, it is necessary to detect a very feeble ionisation of the air amounting in the average to a few ions, say 1 to 2 per c.c. per sec. at the sea level.

In 1929, Regener reported that the phenomenon of residual ionisation could be observed in Lake Constance even at depths of 750 feet below the surface and found that the relation between the intensity of ionisation and depth could be represented by an exponential function; a similar relation also exists in the case of γ-rays. Regener considered that the primary radiation as in the case of γ-rays is electromagnetic in nature. This view has found support by the work of Millikan, and his collaborators. Millikan considers that practically all the residual ionisation is due to electrons (positive and negative) rather than to other heavier nuclei; that about 80 to 90 per cent. of the ionisation is due to the secondary electron rays produced within the atmosphere by the incoming photons and electrons; that there is no evidence that anywhere on the earth more than 2 per cent. of the ionisation found at sea level is due directly to the incoming electrons which is responsible for the latitude and the East-West variation of the intensity of the ionisation; that the earth's magnetic field separates the incoming secondary electrons with low energy from those with high energy, allowing the former to concentrate near the poles and the latter, which have an excess of positive electrons, to concentrate at the equator and that the greater part of the ionisation of our atmosphere is due to photons with an energy of the order of 200 million electron-volts. In the year 1929, Bothe and Kolhorster, by employing a double Geiger counter arrangement so arranged that the ordinary radioactive radiations could not discharge both the counters simultaneously, adduced evidence to show that the cosmic rays consist of high velocity electrons. Bothe and Kolhorster found no variation of the intensity of ionisation with respect to the latitude between Hamburg and Spitzbergen, while Clay had found a decrease of the intensity of ionisation near the Equator in his geographic investigation of the cosmic ray intensity between Holland and Java. The extensive geographic study of the ionisation intensity organised by Professor A. H. Compton in several parts of the world have however shown that there is a genuine *geomagnetic* latitude effect, an East-

West effect and an altitude effect. These results can be very well interpreted according to the theory of the motion of electrons round a magnetic doublet (earth being considered as a magnetic doublet), a theory first enunciated by C. Stφrmer of Norway, who interprets the origin and forms of *aurora-burealis* and the same theory has been extended by Lemaitre and Vallarta to interpret the asymmetric distribution of cosmic ray intensity on the basis of the corpuscular hypothesis. The investigations of the Italian school led by Rossi gave similar evidence for the existence of the asymmetry. Johnson's investigations on the distribution of the cosmic ray intensity support the corpuscular hypothesis and suggest that the corpuscles should consist exclusively of positrons. Clay has, recently, come to the conclusion that the primary radiation is of corpuscular nature, consisting of electrons, positive and negative, with energy 1-200 million electron-volts, and that this corpuscular radiation produces ultra-gamma photon radiations with energy 10^7–10^{10} *e*-volts. This produces secondary corpuscular radiation with 10^6–10^9 *e*-volts, which in turn produces gamma radiation with energy 10^8–10^7 *e*-volts, which finally produces the corpuscular radiation with energy amounting to 10^7 *e*-volts.

Skobelzyn, Anderson and their co-workers and also Blacket and Ochialini have obtained beautiful photographs of the showers of the corpuscular tracts in the Wilson Chamber. These showers are the paths of the secondary particles diverging generally from a point in the material enclosing the Chamber. Many other aspects of these showers have been examined by other investigators.

The question of the fluctuations in the intensity of cosmic radiation, has attracted a good deal of attention. In the year 1927, Hoffmann discovered the occurrence of sudden bursts of ionisation at certain times. This phenomenon was disputed by the workers of the Millikan school who attributed it to the discharge of the battery in the instrument employed for recording the ionisation. Swann and Compton have shown that Hoffmann's observation was not due to the battery, and more recently Hoffmann has shown that the phenomenon is genuine and is really fundamental. Dr. and Mrs. Montgomery investigated the dependence of the Hoffmann Strosse on the altitude and on the thickness of the material of the ionisation chamber. When the number of the ions are of the order $\cdot 5\times10^5$, the rate of occurrence of the bursts at Swarthmore (61 m.) was 0.4 per hour while it was 260 per hour at Pike's Peak (4300 m.). When the number of ions is greater, of the order 1.5×10^6 they found no appreciable difference in the frequency of occurrence between Swarthmore and Pike's Peak. They also found that the bursts increased with the thickness of the shielding. Thus this new kind of very penetrating radiation, coming in from outside, possesses many new and interesting properties.

N. S. N.

Academies and Societies.

Indian Academy of Sciences:

October 1935. SECTION A.— S. M. SHAH: *On Inequalities Satisfied by Certain Arithmetical Functions II.* D. D. KOSAMBI: *An Affine Calculus of Variations.* S. R. SAVUR: *A Simple Test of Value of a Particular Period in Forecasting.* S. BHAGAVANTAM: *Rotational Raman Scattering in Benzene.*—Results with a high dispersion spectrograph confirm those obtained hitherto with low dispersion instruments. The observations of Sirkar and Maiti are not confirmed. S. RAMA SWAMY: *X-Ray Analysis of the Structure of Iridescent Shells.—Part II.—The Haliotidæ.*—There is a preferred orientation of the *a* and *b* axes with a large error in the orientation. W. M. VAIDYA: *The Flame Spectra of Some Aromatic Compounds.*—The bands attributed to HCO are found to occur. The hypothesis of direct incorporation of the O_2 molecule explains the spectroscopic observations better than that of successive formation of hydroxyl groups. D. S. SUBBARAMAIYA: *Light Scattering in Gold Sols in Relation to Particle Size and Shape.*—In all the sols examined the shapes of the particles are far from being spherical. K. L. RAMASWAMY: *Dielectric Coefficients of Volatile Compounds of Fluorine and Boron.*—The moments of CF_4, NF_3, $(CF_3N)_2$, B_2H_6 and $B_3N_3H_6$ have been determined in the vapour state, and their structures discussed. BAWA KARTAR SINGH AND I. MAHANTI: *The Physical Identity of Enantiomers.—Part I.*—Rotatory dispersion of *l*-Borneol, enantiomeric camphors, camphoric acids, sodium camphorates, camphoric anhydrides, and camphorimides. S. CHOWLA: *A Remarkable Property of the "Singular Series" in Waring's Problem and Its Relation to Hypothesis K of Hardy and Littlewood.* T. A. VAHIDY AND K. C. PANDYA: *The Condensation of Aldehydes with Malonic Acid in the Presence of Organic Bases.—Part IV.* The Condensation of Piperonal. C. V. RAMAN AND N. S. NAGENDRA NATH: *The Diffraction of Light by High Frequency Sound Waves.—Part I.*—A theory of the phenomenon is developed and the calculations interpret the experimental results of Bär in a very gratifying manner. C. V. RAMAN & N. S. NAGENDRA NATH: *The Diffraction of Light by Sound Waves of High Frequency.—Part II.*—The new theory is extended to the case when the light beam is incident at an angle to the sound wave fronts. The results explain the variations of the intensity among the various orders noticed by Debye and Sears for changes in the angle of incidence.

October 1935. SECTION B.—K. RAMIAH AND S. RAMANUJAM: *Chlorophyll Deficiencies in Rice* (Oryza sativa).—Nine types of Mendelian chlorophyll deficiences consisting of both unicoloured and variegated forms have been described and their inheritance discussed. Some of these like the "zebra-marked," lutescent, and certain variegated forms are recorded for the first time in rice. N. L. SHARMA AND S. PURKAYASTHA: *The Heavy Minerals of the "Erinpura" Granite and Microgranite of Danta State (N. Gujrat).*—Twenty

specimens of granite and six of microgranite from the main exposures of the "Erinpura" rocks have been analysed from their heavy minerals. M. DAMODARAN AND M. SRINIVASAN: *Ascorbic Acid (Vitamin C) Content of Some Indian Plant Materials.*—The ascorbic acid contents of a number of indigenous plant materials have been tabulated. The Indian gooseberry gives the highest reducing value by the Tillmann-Harris technique among the materials examined (See *Curr. Sci.*, 1935, **3**, 353). B. N. SINGH: *The Correlation between Life Duration and Respiratory Phenomena.*—The study of the respiratory index of short-lived and long-lived plants has revealed characteristic differences between the two classes of plants. In the short-lived plants, the index decreases for an early phase of the fourth cycle, the rate of fall becoming more pronounced before the initiation of the reproductive organs. In the long-lived plants, on the other hand, the rate is more or less steady and shows a stop only towards the end of the growth cycle. J. DAYAL: *Studies on the Trematode Parasites of Indian Fishes I.*—A New Trematode, *Monorchotrema taakree* n. sp. from a Fresh Water Fish, *Pseudeutropius taakree*, from Lucknow.—A trematode of the family Heterophyidæ found as an adult in the intestine of a fish (*Pseudeutropius taakree*) has been described. S. B. KAUSIK: *The Life-History of* Lobelia trigona *Roxb. with Special Reference to the Nutrition of the Embryo-Sac.*—The nutritive mechanism of the embryo-sac has been described.

University and Educational Intelligence.

Annamalai University:

1. *The Founder's Day.*—The Sixth Founder's Day was celebrated on the 12th October, 1935, under the presidency of the Right Hon'ble V. S. Srinivasa Sastri, P.C., C.H., LL.D., Vice-Chancellor of the University. Captain M. Abdul Hamid, M.A. (Oxon.), Principal, Government Mohammedan College, Madras, delivered the Address.

2. *Convocation.*—On the 31st October, 1935, the Fifth Convocation of the University for conferring degrees, diplomas and titles was held when His Excellency Lord Erskine, G.C.I.E., Governor of Madras and Chancellor of the University, presided. Sir Mirza M. Ismail, Kt., O.B.E., Dewan of Mysore, delivered the Address to the graduates. 103 candidates were presented at the Convocation besides 41 who took their degrees and titles *in absentia*.

An ordinary meeting of the Senate was held on the same day at 3 P.M. The following resolutions moved by Mr. G. Srinivasa Ayyar were adopted:—

i. The Senate recommends that a Bureau of Information of careers for graduates be opened at the University to provide facilities for the employment of the graduates.

ii. The Senate resolves that an official register of the graduates of the University be maintained and revised every year to give particulars of their address, employment and achievements.

The Senate also approved of the proposal of the Syndicate to institute for a period of 3 years a teaching post in the grade of a lecturer for the Department of English, in view of the large number of students admitted this year and the additional work entailed thereby.

3. *Special Lectures.*—On the invitation by the Syndicate, the following persons delivered courses of special lectures during October, 1935:—

Dr. H. Parameswaran—3 lectures on "Vacuum Technology." Prof. P. Sambamurthy—4 lectures on "South Indian Music," with an Orchestral Concert on the 2nd November.

4. *Library.*—The University Library has been re-organised with a view to making it more useful to the staff and students. Provision has been made for a spacious reading room and arrangements have been made for the Library to work from 7 A.M. to 7 P.M. on all days of the week including Sundays.

5. *Inter-Collegiate Debate.*—Under the auspices of the University Union, an inter-collegiate debate was held on the 19th October in which representatives of the Madras Colleges (Presidency, Christian, Pachaiyappah's and Loyola) participated. The subject of the debate was:

"That Science can achieve the moral well-being of humanity more effectively than religion."

Messrs. C. Jagannathachari of the Annamalai University and K. Rangachari of the Christian College, Madras, were adjudged the best speakers and awarded a prize each.

Under the auspices of the Sanskrit Society, M. R. Ry. K. Balasubrahmanya Ayyar Avl., B.A.,B.L., Madras, delivered the Inaugural Address. The occasion was availed of to have the portrait of Mahamahopadhyaya Vidyavachaspati S. Kuppuswami Sastriar, M.A., I.E.S. (Retd.), Professor of Sanskrit and Comparative Philology, Presidency College, Madras, unveiled by the Vice-Chancellor.

6. *Talks on Popular Subjects.*—A system by which a member of the Staff gives a talk to the students every week or a fortnight on a subject of popular interest, was inaugurated in September last by the Vice-Chancellor.

The following members of the Staff gave talks on the following topics:

The Vice-Chancellor: on "The Italo-Abyssinian dispute."

Prof. M. S. Sundaram: on "The Far East."

Mr. V. R. Viramani: on "The Sanctions."

7. *Elections.*—The Elections to the several University authorities that are now being reconstituted are in progress and the new bodies will function from 6th December 1935.

Andhra University:

The following candidates have been qualified to receive the degrees noted below:—

Doctor of Philosophy: A. Veerabhadra Rao, M.A. Title of Thesis: "Studies on Raman Effect." I. V. Radhakrishna Rao. Title of Thesis: "Sirrhosis of the liver in Northern Circars."

Master of Science: Mr. D. S. N. Murti, B.A. Title of Thesis; "Isomerism in Organic Chemistry."

REVIEWS.

La Spectroscopie Appliquée. Par P. Swings. (Paris: Hermann et Cie, 1935). Pp. 188. Price 15 fr. Paper Cover.

The most important practical application of spectroscopy is to be found in the analysis of the chemical constitution of the source of radiation and has had spectacular success in giving information about the heavenly bodies. The more mundane question of the determination of the chemical constitution of different chemicals, alloys or minerals is no less successfully attacked by the methods of spectroscopy. Its greatest utility is due to the fact that constituents present in very minute quantities can be detected and the amount of the substance required for the analysis is also small. Local examination of intrusions in a metal, etc., is another domain where spectroscopic methods are supreme. Though qualitative analysis has been known to be a commonplace application for a long time, it is only recently that methods of quantitative analysis have been giving reliable results. Nowadays, however, many industrial laboratories employ spectro-analytical methods on account of their sensitiveness, rapidity and small demand on the amount of substance necessary. The book under review has been written by one who has made contributions to the study of band spectra. It is an admirable resumé of the methods of qualitative and quantitative spectro-analysis. The most recent researches have been taken into consideration and the practice made quite clear by definite instructions. The rationale of the methods, their advantages, fields of application and limits of error have been well discussed so that a careful choice of the most suitable technique in any case will be easy for any one who seriously studies the book. The discussions and instructions are always brief but clear and to the point. A number of tables not given in the book would be required in practice but the bibliography in the book makes it quite easy to find the required information. Applications to Biology and Medical Jurisprudence are touched upon and in the end a very brief summary of the theory underlying the unravelling of atomic and molecular spectra is given. With occasional reference to the larger treatises mentioned in the text, the volume will serve as an admirable handbook for the industrial spectroscopist.

T. S. S.

Optical Rotatory Power. By Professor T. Martin Lowry, C.B.E., M.A., D.SC., F.R.S. (Text Books of Physical Chemistry.) (Longmans, Green & Co., Ltd. London, New York and Toronto.) 1935. Pp. xiii+483. 30s. net.

Professor Lowry and all chemists interested in optical rotatory power are to be congratulated on the appearance of this excellent book. It is a landmark in the study of optical activity, and is a record of work and progress in polarimetry, extending over a period of 120 years, from the original discovery of the optical rotatory power of Quartz by Biot in Paris (1813) to the recent theoretical work of Max Born in Cambridge, which has at last provided an adequate physical basis for the interpretation of one of the most difficult of optical phenomena.

Part I, Historical and General, besides describing the pioneer work of Biot and Fresnel, includes the epoch-making researches of Pasteur on Molecular Dissymmetry as well as those of Le Bel and Van't Hoff, which provided a firm foundation for the Science of Stereochemistry. This section also records the work of Pope and Werner. On the physical side, an account is given of Biot's Law of Inverse Squares, with its subsequent modifications culminating in the well-known formula of Drude, which suffices to express the rotatory dispersion of transparent media of all kinds with remarkable precision. Cotton's discovery in absorbing optically-active media of the twin phenomena of circular dichroism and of anomalous rotatory dispersion is also included. One of the most important phenomena of optical activity, namely, the Asymmetric Synthesis is also treated. The successful experiments of Freudenberg, Kuhn and Braun in realising for the first time, the preparation of an optically active compound under the influence of circularly polarised light is dependent on the utilisation of Cotton's discovery of circular dichroism. Just as Wohler's synthesis of urea shook the belief in the old vital force theory of the preparation of organic compounds, so, by the artificial making of a one-sided optically active substance in excess, a further advance is made on the road linking organic with inorganic nature. The significance of these results is enormous: they show that in principle no vital force is necessary for the

production of optically active compounds and thus refute Japp's dictum that "the absolute origin of compounds of one-sided asymmetry to be found in the living world is a mystery as profound as the absolute origin of life itself." The section closes with an account of Magnetic Rotatory Power and its application to studies of the chemical constitution of organic compounds. It is to be regretted that a very important and puzzling phenomenon of optical activity, the Walden Inversion, is left out and it is hoped that this omission will be rectified in a second edition of the book.

Part II, Polarimetry, is a very complete record of the development of polarimetric apparatus for the measurement of rotatory dispersion in the visible, ultra-violet and in the infra-red regions of the spectrum. The last chapter in this section is devoted to the measurement of circular dichroism, the significance of which is already pointed out in the foregoing paragraph. This section will doubtless be found very useful to workers in this field of optical investigations.

Part III, Special Cases, records the application of polarimetric methods to the study of the following substances: quartz, amyl alcohol, *iso*-valeric acid, tartaric acid, malic acid, lactic acid, sugars, camphor, borneol, nicotine, and some of Werner's coloured co-ordination compounds. This section also treats of a number of important problems of general interest, *e.g.*, Hudson's "iso-rotation rules", the phenomenon of muta-rotation, discovered by Dubrunfaut in 1846, anomalous rotatory dispersion and circular dichroism. The author has drawn largely from data published by himself and his students.

Part IV, Theoretical Considerations, gives an account of optical rotatory power of crystals, "liquid crystals" and solutions. This section is, however, devoted mainly to recent work on rotatory dispersion in transparent and absorbing media with a view to express the magnitude of their optical activity by means of mathematical equations. Kuhn, Gray, de Mallemann and Boys have attempted to co-relate optical activity with other optical and chemical properties of a substance by using different methods. Boys finds a rather simple expression for the rotatory power, which contains nothing else but the refractivities and the effective radii of the chemical groups involved. This theory cannot explain the fact that a strong absorption band may make a very small contribution to the optical activity and *vice versa*. "The real theory of optical rotatory power may be found by the mathematician, but is concealed from the chemist, in the papers of Born" says Prof. Lowry, "who recognised that *four* coupled electrons are required to produce optical rotatory power." A survey of Born's theory is included.

The book is well printed and illustrated. The number of mistakes is indeed very small in a book which contains so much matter.

BAWA KARTAR SINGH.

Elementary Electricity and Magnetism. By N. Robert W. Hutchinson, M.Sc. (University Tutorial Press, Ltd., London.) Pp. 475. Price 6/6.

In this excellent volume Mr. Hutchinson has set forth with great lucidity the elements of Magnetism, Static and Current Electricity. Within less than 500 pages of large print, the author has provided a wealth of theoretical and practical information that will more than cover the average Intermediate syllabus in India. In addition—and this constitutes the greater value of the book—he has brought the matter right up to the minute almost, by including brief but simple and clear accounts of the latest developments, *in theory and practice*, of physical science. The student of science as well as the "man in the street" hears so much about these developments that his curiosity is naturally aroused. In this book he can learn a good bit about X-rays, Wireless, Atomic theory, Transmutation of the elements, Radio-activity and even Television!

There are innumerable text-books for those who desire to learn just what is needed for examination purposes but here is a work which must be read by all students—if only for the stimulation of that curiosity which has been the foundation of most great discoveries in the past.

P. A. M.

Notes on Organic Chemistry. By F. Francis, Ph.D., D.Sc., F.I.C. (E. Arnold & Co., London, 1935.) Pp. 518. Printed on one side. Price 12*s.* 6*d.*

These notes have been written for the advanced students in the Honours Schools with a fairly sound background of organic chemistry.

In the Introductory portion such diverse

subjects as Theories of Radicals, Concepts of Valency, Isomerism, Rise, Growth and Development of Stereochemistry, Strain Theory, Tautomerism, Applications of Physical Methods to problems of Organic Chemistry, etc., have been dealt with in the space of 42 pages printed on one side. One cannot help feeling that the treatment is cursory and the value of the work is greatly diminished by absence of references to the original papers of the authors cited. For example, the subject of Infra-red Spectroscopy is dismissed in five lines without any reference even to the outstanding papers on the subject. It is doubtful if such treatment would serve any purpose except in merely informing the reader that Infra-red Spectroscopy is one of the methods used in the determination of the configuration of the molecule. Similarly the important subject of dipole moments does not receive any better consideration.

The book is badly revised as numerous serious errors of formulation occur throughout. It is particularly noticeable in Chapter II where the formulæ on p. 66 under 27, on p. 82 under II, on p. 84 under 21 and under III, on p. 86 under 23 are but examples of many similar errors.

The reviewer had some difficulty in understanding the logic of the arrangement of the subjects. It seems that a mass of facts are grouped together without a definite plan. Perhaps some consolation is to be found in the fact that the book is intended to be nothing more than mere Notes—a *vade mecum* for an aspiring organic chemist.

The author has not often been successful in stimulating the interest of his readers. For example, under phenyl hydrazine (p. 496), the three reactions that appealed to him are (*a*) the indole condensation, (*b*) pyrazolone formation, and (*c*) reducing action of phenyl hydrazine. The indole condensation is dismissed with the statement, p. 498: "To a certain extent the reaction is general although its mechanism is not clear". No references, of course, are given to Robinson's work on the mechanism of indole formation or Reddelin's work.

Notwithstanding the defects, the book contains a lot of useful information which would be of help if the reader finds out the proper references himself and makes notes of them in the alternate blank pages provided.

The Chapter on additive reactions of unsaturated compounds gives a useful summary of the recent work on the subject.

One wishes "The Diene synthesis" had been a little more fully dealt with although the account given is excellent in many ways.

The book would be serviceable to the advanced students of chemistry. It is hoped that in the second edition the proofs would be better corrected and references to the original papers would be given where necessary.

J. N. R.

Introduction to Vertebrate Embryology. By Waldo Shumway, Ph.D. (John Wiley & Sons, Inc. New York, 1935.) Pp. xii+390. Price 20*s*. net.

The III edition of W. Shumway's *Introduction to Vertebrate Embryology*, is an addition to the literature in the field of Embryology. As the author rightly points out Embryology is not an easy subject, for the student must possess a capacity to imagine the changing conditions of the embryo and thus mentally reconstruct a three-dimensional picture of the embryo from stage to stage. The book is divided into five parts and each part contains a large number of chapters and each chapter concludes with a concise summary and a list of the more important reference papers. Part I, besides giving a brief account of the genesis of the study of Embryology, also describes the life histories of chordates like Amphioxus, Frog, Chick and Man in a very elementary way. The next two chapters deal with early Embryology and Organogeny. In Chapter IV on Chromosomes and Genes, brief descriptions are given of the Sex chromosomes, Linkage, Crossing over, Chromosomal aberrations, etc. Embryonic form and extra embryonic structures is the subject-matter of Chapter VI. How the form of the body is to a large extent governed by the shape of the gastrula as well as the extra embryonic structures is described. In describing the yolksac, it is said (p. 136) that "In other mammals (Fig. 68) the endoderm grows completely around the interior of the trophoblast and forms a larger yolk-sac." How about the yolksac in forms like Cavia where the distal wall is absent? It may be noted here that Fig. 6 refers to a sagittal section through early gastrula of pigeon. We feel that the author should have described in greater detail the formation of amnion in mammals and discussed the nature of the amniotic cavity in forms like guinea pig and Primates. On

p. 144 in a short paragraph on the "Allantois of man and other mammals," the author points out that "In most of the mammals there is a well-developed allantois, arising like that of the chick.... but the human allantois is rudimentary." A knowledge of comparative embryology tells us that no doubt the allantois arises as in chick and is well developed in mammals, but certainly as a rule in Primates (including man), it is rudimentary. A serious mistake is committed by the author in the paragraph on "The Placenta" (p. 145). It is said that "In Perameles (Fig. 93 B), an allantoic hemiplacenta is formed by the union of the allantoic sac with the trophoblast. Where this hemiplacenta touches the mucosa the epithelium of the latter thickens and is invaded by maternal capillaries. The trophoblast is said to be resorbed so that the capillaries of the allantois come into intimate connection with those of the uterus." When we say that the "epithelium of the latter thickens" it obviously gives us an idea that the cells increase in size and thickness, but really the cells become syncytial and again, the trophoblast is never resorbed, for it unites to form a large syncytial layer with the uterine mucosa. The next chapter on Experimental Embryology is interesting. The well-known rule that development is epigenetic is stressed ; and given a suitable inheritance of genes and a favourable environment, it is noted that development proceeds normally. Development ceases due to overdosage of Ultra-violet light, X-rays or radium emanations. A reference is also made to the works of Müller in describing the influence of agencies like X-rays, etc., on the rate of mutation of Drosophila genes. Part IV dealing with the anatomy of vertebrate embryos like Frog, Chick and Pig, assists the student in identifying parts easily. A good account of the various methods used in embryological studies for preparing slides by the ordinary and celloidin methods, reconstruction are clearly described in Part V. A glossary of nearly 15 pages is also given.

The get-up of the book is excellent and the book should find a place in the library of every embryologist.

R.

Forest Research in India, 1933-34. (Manager of Publications, Delhi.) Parts I and II.

A perusal of this booklet makes interesting reading both to the layman and to the scientist. Part I which deals with the Forest Research Institute, Dehra Dun, is of more general interest and gives one an insight into the progress being made from year to year in the more technical aspects of Forestry. Further advances are recorded in Silviculture, particularly with regard to Sal, in statistical methods, in Botany, Mycology and on the economic side.

The study of "Spike" in Sandal has reached a stage when certain definite results can be confidently expected and it is therefore all the more regrettable that the experiments have had to be closed down for lack of support from the Madras Government. Interesting and conclusive results have been reached with experiments in sleeper seasoning and stacking, and a new and improved method of kiln-seasoning has been perfected. In this connection it is interesting to note that Deodar sleepers in the Punjab are to be treated with a wood preservative before use while, on the other hand, the soft-wood sleeper treating plant in Assam has been closed down for lack of support from the Railways concerned ; this latter must mean a heavy blow to the marketing of the Upper Assam soft-woods. A heartening feature, however, is that soft-wood veneers from this area are gradually establishing themslves, particularly in the tea-trade. A notable achievement on the side of wood-preservation, has been the patenting by Dr. Kamesam of the "Ascu" process : a logical development of the Falkamesam process, by which both Arsenic and Copper are "fixed" in the wood. This will mean a considerable reduction in the cost of preservation with an increased degree of protection, although a supplementary impregnation with oil, to prevent splitting, will apparently be necessary. The technique for testing wood-preservatives has also been considerably improved upon marking a distinct advance on the old "graveyard" methods. Investigations into pulp-manufacture have also been continued with satisfactory results.

Turning to the Provinces, we find an extension in the Andamans of the new method of naturally regenerating mixed deciduous forests by removal of the cover from below upwards.

Assam is making steady progress in the regeneration of Sal, in spite of the inroads of Eupatorium and it is becoming increasingly the suspicion of some foresters there that the presence of grass is not absolutely necessary for the production of regeneration,

and that the latter would appear to be largely dependent on certain soil-factors. The working plan for the Evergreen forests of Upper Assam has been brought practically to a stand-still by the closure of the soft-wood sleeper-treating plant.

Bengal continues to experiment with the regeneration of Garjan (Dip. Spp.) and Sal; the latter continues to be the main problem in Bihar and Orissa and the U. P. In Burma stump-planting of teak and the influence of the origin of teak seed on growth and quality continue to demand attention, while in the C. P. the new systems of coppicing adopted in place of the selection and improvement systems have not produced entirely satisfactory results in the best teak forests. In Madras teak again is the species receiving most attention, and valuable results appear to have been obtained in planting and tending. In the Punjab Blue Pine regeneration continues to be difficult, while the Sal problem in the U. P. remains at a stand-still.

Coloured Plates of the Birds of Ceylon. By G. M. Henry. With a short description of each bird by W. E. Wait, C.M.G., M.A., F.Z.S., ETC. Part IV. 16 coloured plates. (Published by the Ceylon Government, 1935.) Price £1–16–0.

There is a Chinese proverb which says that a single picture is worth more than 10,000 words. Nowhere is its application truer than in the case of bird study in India, for one of our greatest handicaps is the paucity or almost complete lack of good illustrations of Indian birds. Not that we have a plethora of bird books; indeed the very opposite is the case, but without pictures bird books would be of little use to the beginner or the layman. Pictures to be really helpful must be coloured, and pictures to be coloured are necessarily costly, and to come back to our starting point in this vicious circle, it is the costliness of colour printing that has so retarded the publication of popular bird books in this country and acted as dead weight against the advancement of this fascinating study.

An effort has indeed been made in recent years to overcome this drawback, and the beautifully illustrated books on the Game Birds of the Indian Empire by Stuart Baker and the set of 5 wall charts depicting about 200 species of the common birds of this country, published at great expense and considerable financial risk by the Bombay Natural History Society, and the *Popular Handbook of Indian Birds* by Hugh Whistler are the foremost examples.

Under the circumstances these coloured plates of the Birds of Ceylon are more than welcome, and the Government of Ceylon is to be congratulated not only upon its enterprise in undertaking their publication, but also upon its discovery of an artist of the accomplishments of Mr. G. M. Henry, an assistant in the Colombo Museum. It is not every artist, however masterful he may be, who can give a pleasing, accurate and lifelike rendering of a bird unless he is at the same time a naturalist and thoroughly familiar with his subjects *in life*. Mr. Henry obviously combines in himself both these attributes, and the plates which are the result of this combination are a real pleasure to behold.

In artistic merit, Part IV which is now before us, fully maintains the high standard set by its predecessors. It contains 16 plates, seven of which depict Passerine species, the remaining nine illustrating various non-Passerine forms.

It is perhaps unfortunate that while illustrating both the male and the female of the Ceylon Red-vented Bulbul, a species in which the sexes do not differ at all in colouration, only the male of the Ceylon Magpie Robin should have been shown. In the Indian race of this bird the black upper parts of the male are ashy-brown in the female, while the black in his lower plumage is replaced in the female by ashy-grey. In the Ceylon race the female is darker both above and below and sometimes indeed so dark that the correct sex can only be determined by dissection. Normally, however, there is sufficient dimorphism to have justified an illustration. We notice that Mr. Wait has attempted to supply this deficiency in his letter-press.

Sundry minor defects of undue accentuation of certain colours or *vice versa* are more or less inevitable in printing of this kind—for example there is too much blue in the back of the female Orange Minivet—but on the whole the reproduction of the plates is commendable.

The short descriptions of the birds by Mr. W. E. Wait, to whose well-known *Manual of the Birds of Ceylon* these plates are meant to be supplementary, touch upon the salient points in the distribution and habits of each species, but in our opinion measurements given in inches and such irritating decimals as "0·7" for example, are an

anachronism that is thoroughly inexcusable in a modern work even of a popular-*cum*-scientific nature. We cannot help thinking that the present work suffers appreciably in scientific value from the adoption of the inch as the unit of measure rather than the more rational and universally accepted millimeter.

The ultimate scope of the work is unknown so we do not know how many further parts to expect. We can only hope, however, that we may still look forward to many more of Mr. Henry's beautiful drawings and that the Ceylon Government will continue its useful and munificent work of sponsoring a publication, which, by the very nature of its sumptuousness, they cannot perhaps look upon as likely to prove a financial success.

S. A. A.

Biochemical and Allied Research in India, 1934. (Published by the Society of Biological Chemists, India. Bangalore Press, 1935.) Pp. 107. Price Re. 1.

The Society of Biological Chemists, India, has just issued its annual publication *Biochemical and Allied Research in India*, 1934. At the moment, this publication is the only one of its kind in giving us, at least in part, a measure of the chemical research carried out annually in this country. We wish that other Societies will emulate this example in publishing such annual reports in other branches of chemistry as well. For this purpose, the birth of the National Institute of Sciences and the Indian Academy of Sciences is a very happy augury.

In the present publication, the fifth in its series, the reviews on different aspects of biochemistry, written presumably by experts in the field, are exhaustive without being critical. This tendency on the part of the reviewer to be complete has resulted in a repetition of themes. Thus the work on nutrition is dealt at length in three different sections, though there could be only one place for it. It is a little amusing to read about problems of fruit preservation being discussed in a section on animal husbandry. It was possible, as in the previous years, to have presented the matter more systematically. The publication afforded the best opportunity to the Society of Biological Chemists to have offered felicitations to its two sister-Societies—the Indian Society of Soil Science and the Indian Physiological Society—started during the year.

Despite the best endeavour on the part of the reviewers to include every reference, a few have escaped notice. Being at the mercy of the belated foreign chemical abstracts for getting at Indian work, the authors of the review could not have done better. But there can be no extenuating circumstance for certain flagrant omissions, as, for instance, of the publications of the Indian Lac Research Institute, Ranchi.

The section on Agricultural Chemistry, which could have started with acknowledgments to the Imperial Council of Agricultural Research for the researches sponsored by it during the year under review, rightly claims the largest space in the publication. The researches, discussed in this section, are those carried out in the various Government Agricultural Departments, including "quake-striken" Pusa, and in the Department of Biochemistry, Indian Institute of Science, Bangalore. A finding by the last-mentioned Department, of special interest to the farmer, is the value of oxidising agents as fertilisers, resulting in one instance in a phenomenal increase of one hundred per cent. in the yield of tomato. Whether this finding, now having only a cloistered virtue, is capable of wide application in agricultural practice, is a matter deserving the attention of some co-ordinating scientific body. On another page of this section is described the work of Dhar and co-workers on the photo-chemical transformations in the soil wrought by metallic oxides, facilitating the oxidation of the organic constituents of the soil. Whether this is the cause of the phenomenon, of which the fertilising value mentioned above is the effect, is a question that an inquiring reader of the review is tempted to ask its author.

As with agricultural chemistry, the work reported in other sections of the publication is that carried out mostly in the different Government Departments. These departmental researches, being planned to meet special needs, are necessarily limited in their scope. In relief, stands the section on "Enzymes". The pure biochemist will still miss in this avowedly biochemical review of India a chapter on general biochemistry devoted to problems of fundamental interest. It is hoped that such a section, with the facilities and workers available in the country, will form the most conspicuous feature of the coming publications.

A short sectional title on each page and a subject index at the end would have

greatly added to the usefulness of the publication.

M. SRINIVASAN.

The Indian Sugar Industry. Lecture delivered by B C. Burt, C.I.E., M.B.E., B.Sc , I.A.S., Expert Adviser, Imperial Council of Agricultural Research, Journal of the Royal Society of Arts, 1935, **83**, 919.

In a paper with the above title, B. C. Burt has traced briefly the development of sugar industry in India. The author has pointed out that India can be regarded as the original home of sugarcane and prior to the grant of fiscal protection to Indian sugar industry, India was still in the anomalous position of being at the same time the world's second largest grower of cane and one of the greatest importers of manufactured sugar. Within four years after protection the output of factory sugar increased enormously and it is expected to meet the whole of Indian demand shortly. Organised efforts at establishing the modern sugar industry in India date from the year 1910. The work of Mr. Moreland in arranging for a demonstrative miniature vacuum pan factory, the specific recommendations of the Board of Agriculture in India and the Government's prompt action on them have been outlined. The author then has surveyed the progress made since 1911 and has sketched the achievements of the Coimbatore cane breeding station under the guidance of Dr. Barber. The work of the Indian Sugar Committee (1919–20) and the contributions by Rao Bahadur Venkataraman to our knowledge of cane breeding have been mentioned, the latter in somewhat great detail.

The rest of the paper is devoted to the development after the year 1928. The formation of the Imperial Council of Agricultural Research in 1929, the Tariff Board enquiry and the grant of protection in 1931 are all briefly described.

The paper concludes with a mention of the effects of Bihar earthquake and the possible future of Indian Sugar Industry followed by a critical discussion.

This paper on the whole is a good review of the historical development of modern sugar industry in India but the author has not touched some of the main problems confronting the future of the industry. He has amply dealt with the progress made on the agricultural side and described the achievements of the Coimbatore experimental station in improving the raw material. Besides the very important problem of raw material, the problem of utilising economically the by-products of the industry especially molasses, is also looming large. Topics of such vital interest must have been dealt with in the paper.

G. G. R.

Forthcoming Events.

Lucknow University Special Lectures—Session 1935-36.

PROGRAMME.

*Nov. 16, at 6–30 P.M. Biology Theatre. "Plant-Geographical Barriers." By Dr. B. Sahni, Professor of Botany and Dean.

*Nov. 23 and 24, at 6–30 P.M. Chemistry Theatre. "Alchemy or the Artificial Transmutation of Elements." By Mr. M. Raman Nayar, Lecturer in Chemistry.

Dec. 7 and 8, at 6–30 P.M. Chemistry Theatre. "Adsorption." By Dr. A. C. Chatterji, Lecturer in Chemistry.

*Dec. 13 and 14, at 6–30 P.M. Physics Theatre. "Recent Advances in Wireless and Television." By Dr. Wali Mohammad, Professor of Physics.

*Dec. 21 and 22, at 6–30 P.M. Biology Theatre. "Studies in Indian Liverworts." By Dr. S. K. Pande, Demonstrator in Botany.

Jan. 4 and 5, 1936, at 6–30 P.M. Biology Theatre. "Numbers." By Mr. R. D. Misra, Lecturer in Mathematics.

*Jan. 17 and 18, at 6–30 P.M. Biology Theatre. "The History of Helminthology." By Dr. G. S. Thapar, Reader in Zoology.

Jan. 19, 20 and 21, at 6–30 P.M. Biology Theatre. "Various Theories of Integration." By Dr. Lakshmi Narain, Reader in Mathematics.

*Jan. 25 and 26, at 6–30 P.M. Biology Theatre. "Cultural Variation in Fungi." By Dr. S. N. Das Gupta, Reader in Botany.

(*These Lectures will be Illustrated.)

Erratum.

Vol. IV, No. 4, October 1935.

Page 267, Line 24 under Spiral Structure of Chromosomes, *Read* "....the resting stage the coils are fully stretched and during the later stage the threads divide."

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